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Cold-Working Steel Barsand Strips

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Associate Editor, *American Machinist*

Annealing methods and temperatures—Pickling, and neutralizing the effect of the acid—Machines for drawing, straightening and cutting round stock — Slitting and rolling strip steel

COLD-ROLLED steel is the designation given to all cold-worked steel having a bright finish incident to its working. Formerly, all such steel was cold rolled, but now all the greater tonnage of bars, including rounds, squares, hexagons and other shapes is drawn, while strips and flat wire are rolled.

Before steel is cold worked, extreme care must be taken to insure that it is of right analysis; that it is free from defects; that its structure is uniform; and that it has been properly annealed when necessary.

The first step after analysis and inspection is annealing. And annealing is an art, the importance of which is not to be lightly passed over. The temperature, length of time in the furnace, and the prevention of oxidation are matters requiring both an intimate knowledge of metallurgy and skill in manipulation.

At the plant of the Lancaster Steel Products Corp., Lancaster, Pa., where the data and illustrations for this article were obtained, the annealing temperatures range from 1,880 to 1,575 deg. F., depending upon the analysis and structure of the steel. The steel is kept in the furnace from 3 to 72 hr. Both the temperature and the furnace time are governed by the analysis of the steel and the size of the bars. Certain grades of steel must receive a normalizing treatment, from 1,575 deg. to 1,700 deg. F. and be allowed to cool before the actual annealing takes place.

Bars under ¾ in., as well as all strip and most wire stock, are packed in annealing boxes containing cast-iron borings and sealed with sand. Coke and producer gas are both used as fuels, but it is the intention in the near future to use gas exclusively. The temperatures of all furnaces are controlled by Leeds & Northrup recording potentiometers.

The steel is pickled to remove the oxidation incident to its manufacture, or that may have taken place during

Fig. 1—Machine for cold-drawing bars

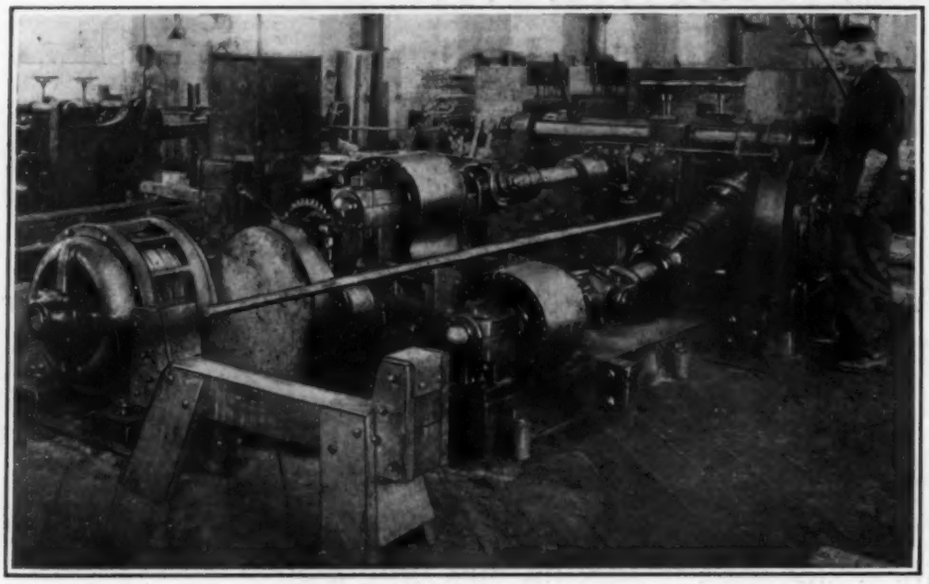


Fig. 2—Straightening machine

annealing when the annealing was performed in the open.

Pickling is done by immersing the steel in a solution of sulphuric acid (66 deg. Baumé) and water, the percentage of acid being from four to eight by volume. The pickling solution is contained in tanks and is heated by steam to a temperature of from 160 to 198 deg. F. The time of immersion varies from 35 min. to 2½ hr., according to the condition and composition of the steel.

As the acid finds lurking places in the very pores of the steel, it will cause rust unless it is thoroughly washed out or neutralized. In fact a certain amount of rust is formed in a very short time after the steel has been removed from the pickling bath. To stop the rusting process, the steel is washed with water and a boiling alkali bath to remove the acid and arrest its action. To make certain grades of steel more susceptible to cold drawing, a rust coating is put on in the pickling room. The steel is first pickled in the usual manner except that the neutralizing bath is not used. After the rust coat has formed the steel is again dipped in a weak sulphuric acid bath and then baked at a temperature of from 250 to 350 deg. F. for from 20 min. to 18 hr., according to analysis, condition and the purpose for which it is to be used. Steels of low carbon or small alloy-content are baked at the lower temperature and for the shortest time, while the reverse is true of high-carbon and high-alloy steels.

After passing through the processes described, the steel is in shape to be drawn or rolled. Bars and rods are drawn through solid dies in a draw bench such as shown in Fig. 1, the rate of speed being anywhere from 18 to 75 ft. per min. according to size and composition. A mixture of soap powder and grease is used as a lubricant. But one pass of the bar is made through the die, and the reduction in size during the process will average about $\frac{1}{8}$ inch.

As the strains set up in the bars in drawing leaves them in anything but a straight condition, they are put through the Medart straightening machine shown in Fig. 2. Here the bars are rotated while they pass between a concave and a flat roll set at an angle to each other. If the rolls are of the right shape and set at the proper angle, the bars will be straightened without being marked by the rolls. Much of the cold-drawn steel to be seen having helical marks of very coarse lead, has been straightened in machines, the rolls of which were either not in proper adjustment or not of the right contour.

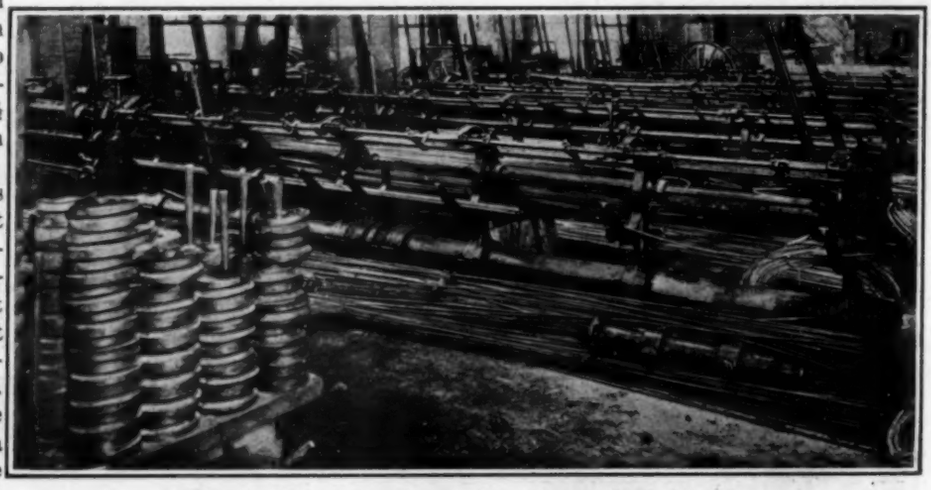


Fig. 4—Straightening and cutting rods to length

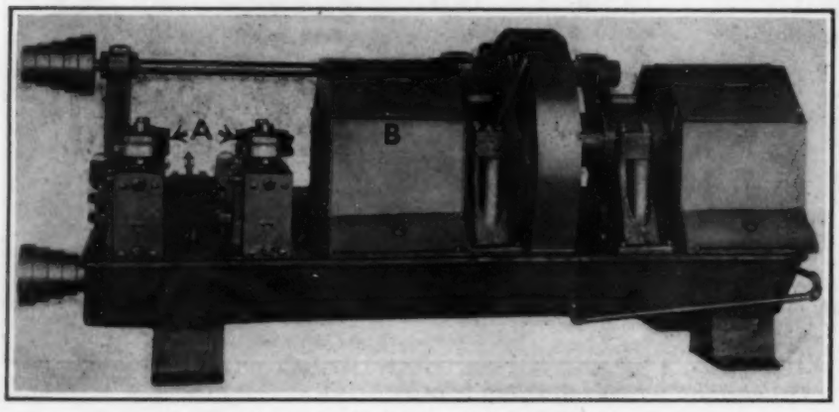


Fig. 3—Machine for turning bars

If, after straightening, surface defects appear, the bars are reduced by turning to the next lower size. Turning, of course is not done in a lathe, but in the Brightman shafting-turning machine shown in Fig. 3. Here the bar is held from revolving, while the cutters revolve around it as it is fed

through the machine by the rolls at *A*. The cutters are held in a ring concealed by the hood *B*. Usually a reduction of from $\frac{1}{16}$ to $\frac{1}{8}$ in. is all that is necessary to remove surface defects. Turned bars must be put through a rolling machine to obliterate the tool marks, and give them a polished surface.

Small bars and rods are also drawn in a machine similar to that shown in Fig. 1, but smaller in size. The straightening and cutting to length are done automatically in Shuster machines, a battery of which is shown in Fig. 4. Bars and rods from 0.013 to $4\frac{1}{16}$ in. are drawn in this plant. In Fig. 5 the method of drawing round wire is shown.

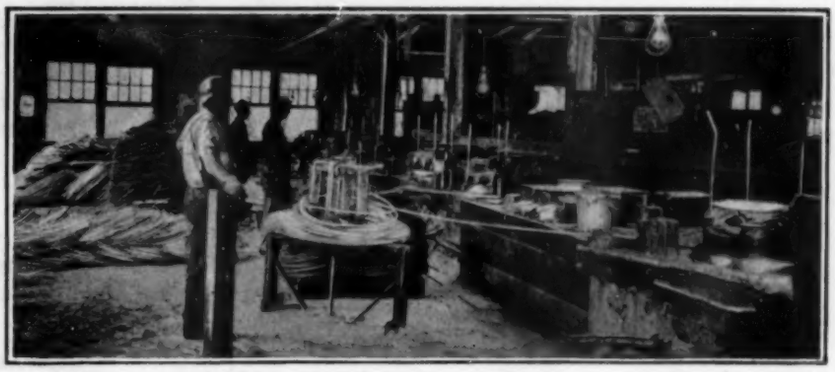


Fig. 5—Drawing round wire

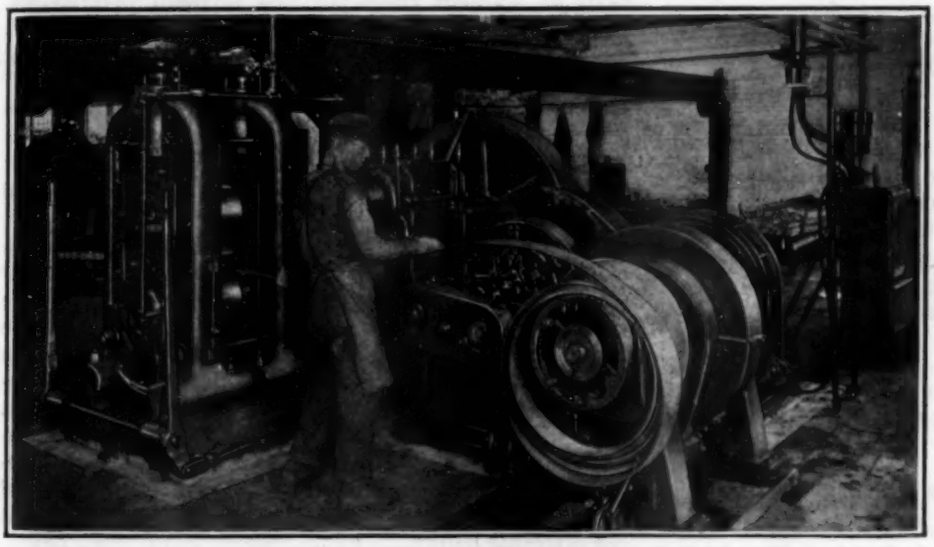


Fig. 6—Rolling strip stock

Drill rod, after being drawn, is polished in machines especially built for the purpose, though the polishing does not change its size.

The raw material for strip stock comes in the form of hoops or bands. Narrow widths are cut from strips of multiple width in a slitting machine.

After annealing, pickling and washing in hot alkali solution, as is done with bars and rods, the strips are passed between highly polished rolls in a rolling mill such as shown in Fig. 6. The finish given to them in this process depends on the finish of the rolls and the amount the stock is reduced. The rolling speed averages about 56 ft. per min., the reduction in thickness being anywhere from 15 to 25 per cent per pass. Generally the total reduction is about 50 per cent. No other finish is given to strip stock than that imparted by the rolls, the surface being sufficiently smooth for commercial purposes.

The cold-rolled strips produced in this plant range from $\frac{3}{8}$ to 10 in. in width.

Accident Records and How to Keep Them

By C. B. Auel
Westinghouse Electric & Manufacturing Company

In the keeping of accident records, it is absolutely essential to have all facts connected with each accident from the causes leading up to it until the case may be considered closed. In the event of a serious accident, it is highly advisable to secure the facts from a number of sources, as the differing points of view may, at times, prove exceedingly valuable. Photographs of the scene of the accident and X-rays of the injured party also are recommended.

Notwithstanding the fact that the majority of accidents occurring in a plant may be of a minor or non-disabling character, like cuts which require nothing more than a bandaging, the medical department should keep a daily record of all cases reported to them, including calls for redressings. This record should embrace the employee's name, check, part injured, notation as to whether or not employee was instructed to continue at work or to call again, etc.

While no set rules for the building up of accident statistics can be formulated which will apply equally well to any and all plants, there are, however, several records at least which must be maintained, if an intelligent study is to be made of accidents, their causes and prevention.

These are:

A. Number of accidents.
B. Accident frequency.
C. Accident severity.
D. Causes of accidents.

The first of these is a record simply of the number of accidents occurring day by day, week by week, month by month, or year by year, which involve lost time to any extent beyond the day or the shift.

But the number of accidents will not of itself be of very much use unless there is kept at the same time a record of the total hours worked by all employees in the plant, not alone so-called production workers but expense workers as well, and in fact all workers, including

From a paper presented at the National Safety Congress, Louisville, Ky., Sept. 29, 1924.

foremen, clerks, etc., subject to accident hazard. This total is called man-hours or hours of exposure, the last meaning exposure to accident hazard.

With these two records, namely: the number of accidents occurring in any given length of time and the total hours worked by all employees during the same period, a computation readily can be made of the number of accidents per hour worked, simply by dividing the number of accidents by the total hours worked. This, however, would make an extremely small decimal to deal with, so it is multiplied by 1,000,000 and the result is the number of accidents per 1,000,000 hours worked or per 1,000,000 hours exposure, or more briefly, if not more simply, the accident frequency, this being the second necessary record.

If the accident frequency increases, for example, in the subsequent, corresponding period; that is, if the number of accidents per 1,000,000 hours worked increases, the accident prevention work may be considered as retrograding and vice versa.

But there is still another record which must be kept to round out the preceding, and that is the amount of time lost due to accidents per hour worked, or the equivalent. It is easily found by dividing the total days lost, due to accidents in any given period by the total hours worked by all employees during the same period. But as this would make, as in the case of *accident frequency*, rather too small a decimal, it is multiplied by 1,000 and the result is the number of days lost per 1,000 hours worked, or per 1,000 hours exposure, or again more briefly, if not so simply, the accident severity, this being the third necessary record.

Making the Figures Intelligible

These methods have been adopted by the International Association of Industrial Accident Boards and Commissions, by the National Safety Council and by statisticians generally, and when it is desired to compare one industry with another, or one works with another or to compute accident ratings, they meet the needs admirably. However, there is an objection to their use inside a plant in that these terms are not easily understood by the average worker. In our own works, therefore, we have felt it better to use, instead, the total hours worked *per accident;* and if we tell the story that in a certain department there has been one accident a month for every 21,600 hours worked, or, since the full-time man averages 206 working hours per month, that we have one man out of approximately every 100 who gets hurt each month, it is something they can grasp. Similarly, with respect to the accident severity, we use the average actual hours lost per accident as a measure, and it is quite evident the workers will the more readily understand you when you say the fellows hurt last year were "knocked out" for 72 hours each or on average of a week and a half, than they will if you tell them their severity rate is .27 as compared with .29 last year.

Nothing has been said as yet as to how fatal accidents or permanent total or partial disabilities are to be taken into account when figuring accident severity rates; for example, if in your plant you had among the accidents one fatality, how would you take it into account in estimating the severity? Of if an accident resulted in permanent total or permanent partial disability, how would it be included? A careful study of these matters by the International Association of Industrial Accident Boards and Commissions has led them to establish a scale of time losses or disability weightings varying with the degree of disability.

As with the methods for determining accident frequency and accident severity, these disability weighting or time losses are quite all right for comparative purposes and in any event nothing else can be substituted for certain of them like the losses set for death and permanent total disability.

For use in one's own plant, however, it does not seem to me necessary to use any figures other than the time actually lost by the employee before returning to his job.

Comparisons of Industries Valueless

Comparison of one industry with another on the basis of accident frequency and accident severity, or even of one works with another in the same industry, seems to me of very little value for other than rating purposes.

In our own works, we do not, therefore, even compare one department with another; but we do compare each department's present performance with its past and in this way all controversy with departmental heads is avoided.

The fourth essential record, causes of accidents, shows by grouping all accidents into their proper classes what the hazards are in a plant and thus enables attention to be concentrated where it will do the most good. This grouping is no easy task either in first deciding on the proper classification or arrangement or in subsequently placing each accident, as it occurs, in its right class. For details as to classifications of causes of accidents, those interested are referred to Bulletin No. 201 of the U. S. Bureau of Labor Statistics, where this matter is gone into at considerable length.

These four records which have been briefly described are considered the absolute minimum which should be maintained in intelligent accident prevention work, though there are others which can be kept also to good advantage; but while these will not be gone into, there is just one other we can recommend and in lieu of a better name, it may be called a calendar of things to be done regularly in accident prevention work. It is simply a list of safety meeting dates and dates of inspection of various items throughout a plant which must be kept up if accidents are to be avoided. Such a calendar would include specifically:

Period	*Items*
6 months	Hand trucks.
6 months	Ladders—portable and stationary.
6 months	Window cleaners' belts and window eyes.
6 months	Stretcher Cabinets.
Weekly	First-Aid Cabinets.
Daily	Cranes, hooks and chains.
12 Months	Crane Operators, Food Handlers } Physical examination
6 months	Hand tools including pneumatic tools.
Daily	Elevators.
12 Months	Hydraulic elevator trucks.
6 months	Electrical hazards.
3 Months	Machine tool guards.
3 Months	Safety meetings.

While the scraping of ships still is being conducted largely in Germany by the use of oxygen-acetylene cutting apparatus, a system using oxygen with gasoline or benzol is attracting much attention. It is contended that it is effective and can be operated at less cost than the other systems.

Erecting Locomotives on Special Forms

By Frank C. Hudson

Methods used by the Baldwin Locomotive Works for alignment of frames and other parts — Miscellaneous jacks and temporary blocking formerly used have been eliminated

THE increasing size of locomotives has made it necessary to devise new methods for handling the frames and other parts during erection. For, while the erection of a locomotive was formerly a comparatively easy matter, the handling of frames that are 9 in. thick and weigh 40,000 lb.—more than some of the complete locomotives of the earlier vintages—requires the use of new devices.

Just as the satisfactory operation of any type of machine depends on the proper alignment of its base or bed, so the performance of a completed locomotive

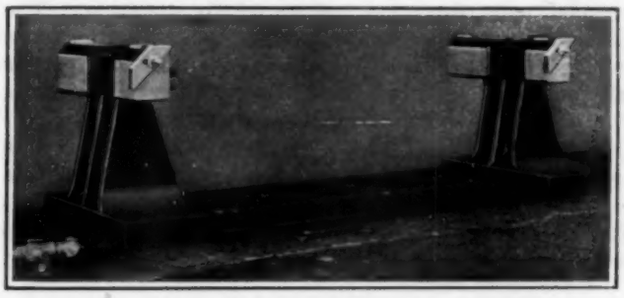


Fig. 1—The erecting form

depends on the accuracy of the erection of its frames, cylinders and other foundation parts. Much of the need for heavy repairs, including broken frames, sharp flanges, loose splice bolts and similar defects is attributed to inaccurate alignment and faulty erection of the frames and other foundation elements.

The large size and weight of the parts in the modern locomotives, have made the old method of supporting the main frames and cylinders on jacks and then leveling and squaring by plumb bob, etc., reaming holes and bolting together, out of date. To simplify the erection of heavy locomotives, John P. Sykes, senior vice-president of the Baldwin Locomotive Works, Philadelphia, Pa., devised the erecting forms illustrated herewith, the photographs being from the Baldwin plant at

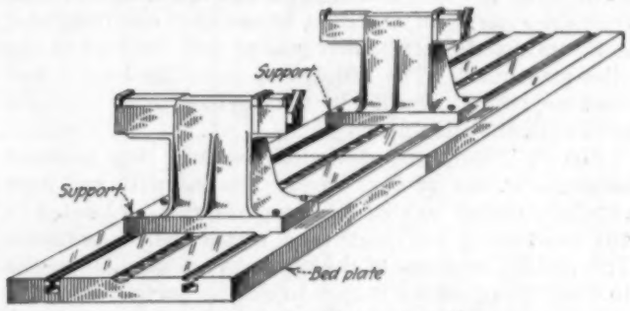


Fig. 2—Details of construction

Eddystone, Pa. The construction of the forms themselves is shown in Figs. 1 and 2. The forms are carefully built so that when the frames are put in place, their alignment is assured without depending on the personal judgment of the workman.

In order to maintain accuracy it is, of course, necessary to have the erecting forms well supported so as to avoid deflection, even under the load of the heaviest

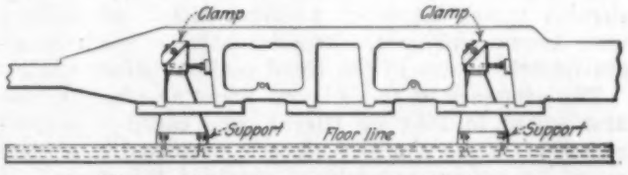


Fig. 3—Securing frames to the forms

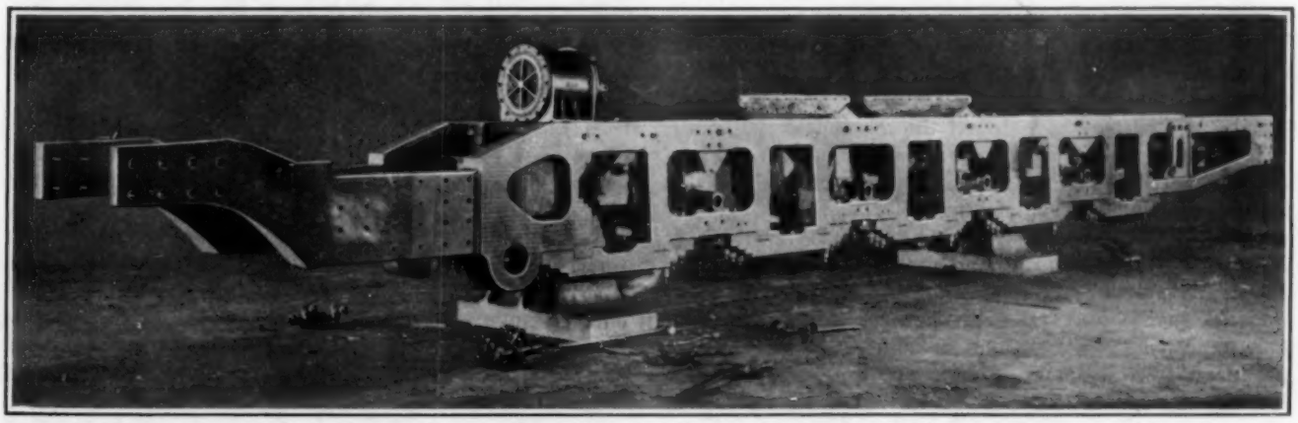


Fig. 4—A decapod frame in position

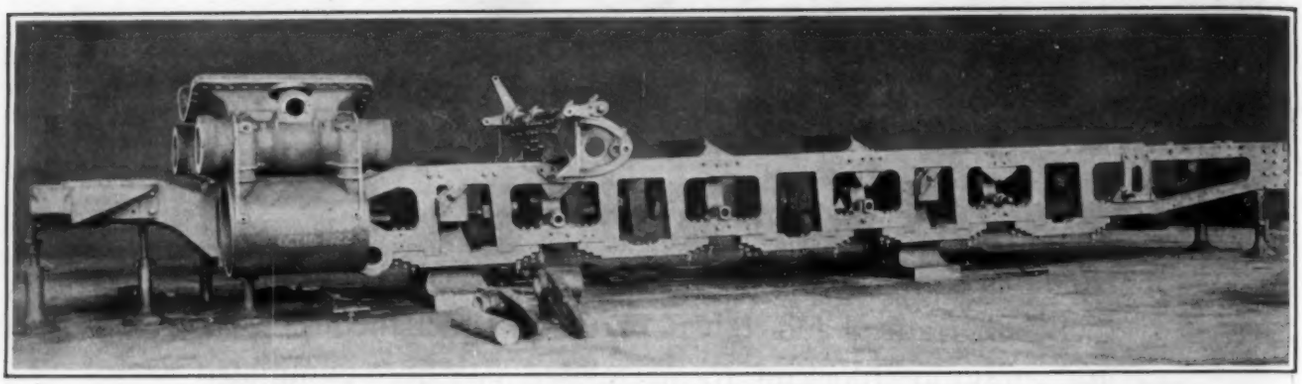


Fig. 5—Ready to receive the boiler

locomotive to be erected thereon. To insure the desired rigidity, the bedplate is supported on twelve heavy, concrete piles which are driven down to a solid-rock formation. The bedplate is of cast iron, 8 in. thick, 80 in. wide and 24 ft. long. It is machined all over and rests on a series of cast-iron beams that are imbedded in a reinforced-concrete mat poured over the tops of the piles mentioned. The bedplate is carefully leveled and concrete poured around it, the surface being brought level with the shop floor.

The two supports, designed to carry the heaviest locomotives, are of cast steel. The bedplate has been carefully planed so that the supports may be located in any position in its length and retain their alignment. The vertical surfaces of the supports are at right angles to their tops, making it easy to line up parts in erecting the locomotives.

The front support is bolted solidly to the bedplate and the rear support is so positioned that when one frame of the locomotive is lowered by the crane, the supports enter the pedestal openings. Side-clamps hold the frame against the raised projections shown in Figs. 1 and 2. Hand-operated screws force the frame back so that the vertical, front jaws of two of the pedestals bear against the front faces of both supports as in Fig. 3. The second frame is treated likewise.

When both frames are in their proper relative position, they are parallel and horizontal and ready to have the cylinders, cross-ties, foot-plates, motion bearers, etc., bolted in place. With the parts machined to gage there is no difficulty in assembling and there is no springing or wedging. The bolt holes are then finally reamed and the parts bolted solidly together. The boiler and its supports are put in place while the foundation parts are held rigidly in position and proper alignment is easily secured. Fig. 4 shows the frames for a Pennsylvania decapod in position.

When the locomotive is ready to be placed on its wheels, it is lifted from the forms and lowered into position over the wheels which are waiting on an adjoining track. This method makes only one lift necessary, and erection is completed without further handling.

A Bit of Nickel History

In circular 100 of the Bureau of Standards, we read that long before the isolation and recognition of the element nickel, alloys of a copper-nickel composition were known and used. Representative of such alloys are Bactrian coins of the third century before Christ.

The existence of the mineral know as niccolite was first stated in 1694 by Hiarni, who called it copper-nickel, or "false copper," since it possessed a reddish color, yet no copper could be obtained therefrom. It was not until 1751, however, that the metal itself was discovered and isolated by Cronstedt, who recognized it as a new element and metal and in 1754 named it "nickel." Cronstedt's discovery was confirmed in 1755 by Bergmann.

In 1804 Richter showed that the metal was malleable, ductile, and possessed a high tensile-strength. Fleitmann, in 1879, made an even more malleable nickel by the addition of magnesium.

The nickel and cobalt industry was first developed in 1830 at Birmingham, England, by Henry Merry. Until about 1872, practically the whole of the nickel supply was obtained from arsenical ores containing considerable quantities of cobalt, and up to 1875, the nickel was produced in the form of cubes or rondelles. Henry Merry appears to have been the first maker of an efficient substitute for "packfong," a copper-nickel-zinc alloy very long known in China. In about 1830, he, in conjunction with Charles Askin, carried out experiments which led to the development of "Merry's plate" and "Merry's metal blanc." Prior to the introduction of electroplating by Elkington, Merry and his brother patented, in 1836, a process for silver plating on this metal. The production of nickel up to about 1870, amounted to probably not over 200 tons per annum. The introduction of nickel coinage in Germany after the Franco-Prussian War, stimulated the nickel industry.

The first record of nickel being used for producing a bright electrodeposit was made in 1843 by Boettger. Owing to the high price of the metal and the difficulty of obtaining it in a sufficiently pure state, it was not until 1870 that nickel plating was established as an industry.

At the New York exposition held in 1853, nickel-iron alloys were exhibited, although accounts of the preparation of nickel-iron alloys had been published by Stodart and Faraday as far back as 1820. Later, in 1888, James Riley, in Scotland, began experimenting with a series of nickel steels prepared by Marbeau, who had, during the preceding few years in France, been working on the preparation of these steels by the crucible process. Riley's epoch-making results were published in 1889, first demonstrating the general properties of nickel steels, as well as pointing out their commercial value. This group today is the most widely used of all alloy steels.

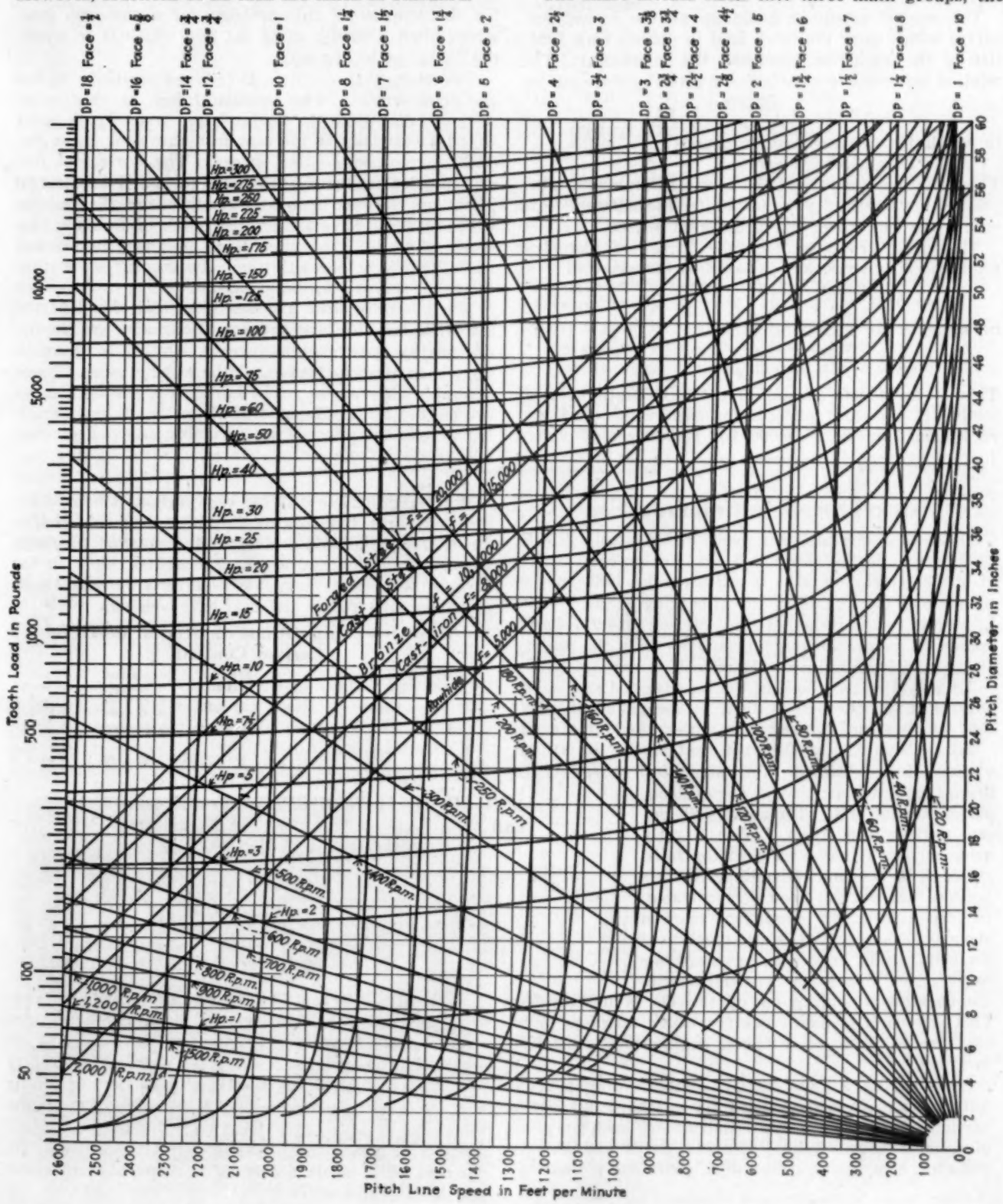
A Design Chart for Industrial Gears

By T. F. Stacey

THE American Society of Mechanical Engineers through its Joint Committee on the Standardization of Industrial Gears has recommended that the face width be fixed for each size of tooth. The face width recommended is approximately equal to 10 divided by the diametral pitch, the proportion generally accepted. However, fractions of an inch are taken as standard.

This standardization simplifies the design of gears and, since it removes one of the variables from the equation, the chart on the opposite page has been plotted to include all the remaining variable factors. This chart permits the selection of the proper gear without any mathematical calculations.

The chart divides itself into three main groups, the



first of which is the group of r.p.m. curves. These curves give the pitch line speed when plotted against the pitch diameter, the relation between the factors being shown by the following equation:

$$V = \frac{\pi DN}{12}$$

in which

V = Pitch line speed in ft. per min.;
D = Pitch diameter in inches;
N = R.p.m.

The second group is made up of the horsepower curves which show the tooth load in pounds as a function of the pitch line speed and the horsepower. The relation between these variables is given by the equation

$$W = P\left(\frac{33{,}000}{V} + 55\right)$$

in which W = Tooth load in pounds;
P = Horsepower.

This equation is a part of the Lewis formula and takes account of the velocity correction, or the allowable load on a given gear when run at different speeds.

The third group includes the curves of diametral pitch and fiber stress and is based on the equation

$$W = bf\left(\frac{0.389}{S} - \frac{2.15}{DS^2}\right) = \frac{0.389\,bf}{S}\left(1 - \frac{5.53}{DS}\right)$$

in which b = Face width;
f = Fiber stress;
S = Diametral pitch.

This is the Lewis formula for the strength of gear teeth. It was first plotted, for each value of S and an assumed value of 10,000 for f, between W and a vertical scale of pitch diameter. This curve was then drawn on the chart so that the vertical scale of pitch diameter was projected to the lower horizontal scale. The other curves of fiber stress were then drawn so as to obtain a direct proportion of the values of W, since the tooth load is proportional to the fiber stress.

Since all the variables are plotted, any problem may be solved, but the usual problem is to find the pitch and face of a gear when the horsepower, speed, and diameter are given. For example, the chart can be used for the solution of this problem for a cast-iron gear whose pitch diameter is 22 in., and which is to transmit 7½ hp. at 100 r.p.m.

The 22-in. P.D. ordinate is followed vertically to the 100-r.p.m. curve. The horizontal line at this point is then followed to the 7½ hp. curve from which point we pass vertically to the cast iron curve, or curve for 8,000 lb. per sq.in. fiber stress. The horizontal line at this point lies between the lines for 6 and 7 diametral pitch, and the gear to suit the conditions of the problem will, therefore, have a diametral pitch of 6 and a face width of 1¾ in. The pitch line speed may be checked while following through the solution, in order that excessive speeds may be avoided.

The allowable fiber stresses given for the different materials are for average conditions and are recommended by gear manufacturers. Any unusual conditions such as shock load should be met by using a lower allowable fiber stress. The curves for pitch diameter are plotted for a minimum of 12 teeth. It is interesting to note the effect of undercutting on small pinions.

Nickel Steels in Common Use

Three and one-half per cent nickel steel (S.A.E. 2300 series) is the oldest and best known composition of nickel steel and still constitutes the bulk of the commercial production of nickel-bearing steels. Table I, giving compositions of the various grades, based mainly on the carbon content, is taken from the Society of Automotive Engineers' Handbook.

This steel is used both in the heat-treated and in the natural condition and, in fact, is the principal alloy-steel which is used commercially without heat-treatment.

With about 0.30 to 0.40 per cent carbon it is used without heat-treatment for structural purposes in bridge construction; that is, for eyebars, plates, shapes and, with about 0.25 per cent carbon, for rivets. With slightly more carbon, it has been used for rails, although its economic advantage for this purpose has not yet been demonstrated. In the cold-drawn condition (carbon about 0.30 per cent) it is also much used for bolts, studs, keys, etc., in automobile construction where heat treatment with the consequent scaling off of threads is undesirable. This steel is a standard one for heavy forgings to be heat-treated, such as ordnance, engine, and locomotive forgings.

Steel having a lower carbon-content, ranging from 0.10 to 0.25 per cent, is used for casehardened parts, particularly in automobile construction, such as pivot pins, steering-ball joints, steering gears and worms, ball rods, cam shafts, piston pins, gears and pinions.

From Circular of the Bureau of Standards, No. 100.

With from 0.25 to 0.40 per cent carbon, it is used for stressed parts and forgings, such as rear-axle shafts, jackshafts, front-axle centers, connecting-rod forgings, steering knuckles and arms, crankshafts, etc. In the form of seamless tubing, it is used for front-axle tubes, propeller-shaft tubes, and rear-axle housings.

Table I—Compositions of Grades, Based on Carbon Content

S. A. E. steel number	Nickel Per cent	Manganese Per cent	Carbon Per cent
2315	3.25–3.75	0.30–0.60	0.10–0.25
2320		0.50–0.80	0.15–0.20
2330	3.25–3.75	0.50–0.80	0.25–0.30
2335			0.30–0.45
2340	3.25–3.75	0.50–0.80	0.35–0.45
2345			0.40–0.50
2350			0.45–0.55

Table II—Range of Tensile Properties of Annealed and Heat-Treated 3½ per Cent Nickel-Steel (S. A. E. Handbook, Vol. 1, Sec. D.)

S. A. E. steel number	Annealed			Heat-treated		
	Yield point Lb./in.²	Elongation in 2 inches Per cent	Reduction of area Per cent	Yield point Lb./in.²	Elongation in 2 inches Per cent	Reduction of area Per cent
2315	35,000–45,000	35–25	65–45	40,000–80,000	35–15	65–40
2320	40,000–50,000	30–20	65–40	50,000–125,000	25–10	65–40
2330	40,000–50,000	30–20	60–40	60,000–130,000	25–10	60–30
2335	45,000–55,000	25–15	55–35	65,000–160,000	25–10	55–25
2340	55,000–65,000	25–15	50–30	70,000–200,000	25– 5	55–15

With from 0.40 to 0.55 per cent carbon, it is a standard material for heat-treated transmission gears requiring a scleroscope hardness as high as 70 to 80. At this hardness the steel still retains sufficient ductility to withstand successfully the clashing of teeth in sliding gears and at the same time is hard enough to resist the wear.

Table II gives the physical properties of some 3½ per cent nickel-steels, according to chemical composition and heat-treatment.

Swing-Frame, Portable and Hand Grinding Machines

Special Correspondence

Early swing-frames—Greater freedom of movement needed—More power and better wheels required—The electric motor and the solid wheel aid in the development

THE APPLICATION of the grinding wheel to the shaping and final finishing of such small objects as may be held and manipulated by the hand of an operator antedated machine grinding by many years and was, without doubt, the inspiration behind the conception of artificial grinding wheels as a substitute for natural stones. From grinding small pieces by hand the natural trend of progress was toward the grinding of larger and larger pieces until the weight and cumbersome nature of the work so predominated over the wheel that the idea of allowing the work to remain still while the revolving wheel was manipulated over its surface was forced upon the mind of some bright mechanic of early times and the swing-frame grinding machine resulted.

The primitive form of the swing-frame machine consists of an arm swinging in a single plane from a bracket attached to the ceiling or overhead beams, and a second member jointed at one end to the lower end of the swinging arm, having at the other end a yoke in which a wheel arbor can be mounted.

This construction is made arbitrary by the necessity for depending upon belts as the only means of transmitting power to the wheel. The center about which the first member swings is represented by the first countershaft, which, as its position does not change with the movement of the members, may be driven by belt directly from the line shaft. A second countershaft forms the pivot that joins the first and second members and, though this shaft moves through a circular arc as the first member swings, the center distances separating it from the first countershaft and from the arbor of the grinding wheel are fixed. Consequently it may be driven by belt directly from the first countershaft while through a second belt it transmits power to the pulley of the wheel arbor.

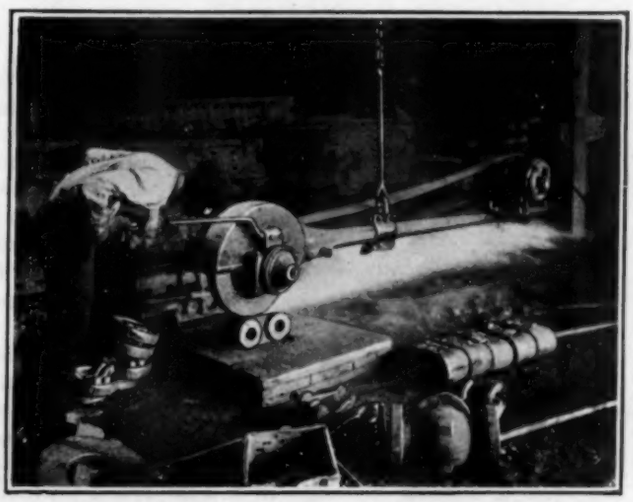


Fig. 1—A semi-portable grinder in action

Such a machine is simple in construction and effective in application within the limits imposed by the belts. At first the wheel could be moved only in a single plane, its range in that plane being circumscribed only by the length of the two main members. Later improvements introduced a swiveling joint in one or both members and wider faced pulleys on the respective countershafts, thereby making the application of the wheel more nearly universal.

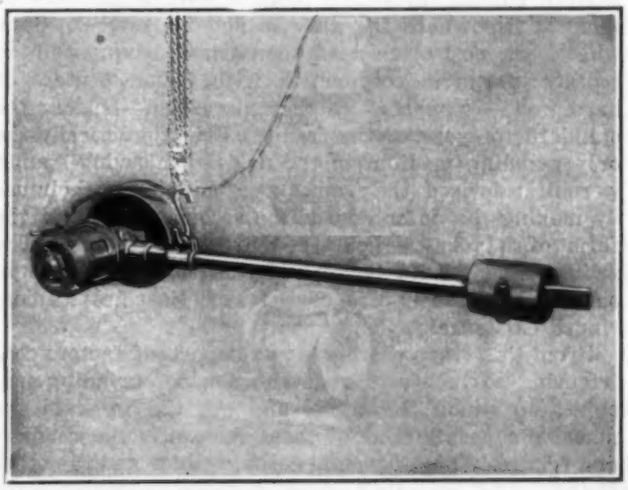


Fig. 2—Another type of semi-portable machine

Modern swing-frame grinding machines, wholly belt driven, are in regular service in the cleaning rooms of foundries and machine shops where castings as they come from the molds are smoothed up, fins, burrs and lumps removed, and made ready for subsequent machining operations. In this work they have to a large extent superseded the tedious process of chipping and filing.

The first form of artificial grinding wheel was probably the wood-center—made by turning and facing a disk composed of a single piece or of layers of thin wood with the grain of alternate layers lying at right

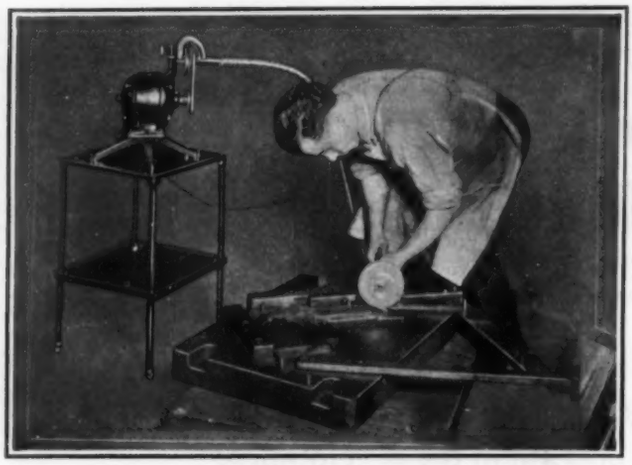


Fig. 3—Wheel driven by flexible shaft

angles and the whole nailed or screwed and glued together—bound by a strip of leather to which the abrasive grains are affixed by means of glue or special cement. Such a wheel may be a very effective stock remover when newly made and, though the coating of abrasive is short lived, it may be renewed again and again at very little expense.

Mounting Wood-Center Wheels

Their inexpensive construction and the facility with which their cutting qualities may be restored make the wood-center wheels strong competitors of their more modern counterparts and there are vast numbers of them in use where the duty is not too severe. Such wheels are most often used upon arbors having pointed centers to run in conjunction with female centers of hard wood—"poppets," as they are called—held in the standards or yoke of the frame. Being practically the only grinding medium in the field when swing-frames were first devised, the frames were adapted to their use by making the outer end of the second member in the form of a yoke to hold the hardwood centers. The swing-frame in its primitive form is still in use in shops where the nature of the work justifies its continued existence.

From this stage there are two important factors contributing to the further development of grinding machines in which the wheel and not the work is the movable element. One of these factors is the compact and relatively high-powered electric motor and the other is the "solid" grinding wheel, made by the vitrification and other processes. The first of these factors divorced the machines from the restraining influence of the belts and made portable machines possible, while the second provided a means of utilizing power far beyond the capacity of the leather-covered wheel and opened to the grinding process a field hitherto untouched.

Of the portable type of grinding machine there are many varieties. The larger machines, used for snagging castings, removing flaws and seams from billets of high-speed and alloy steels, grinding track fittings of manganese steel, etc., usually consist of a frame carrying at one end an electric motor and at the other a wheel arbor connected to the motor by a belt. In service it is suspended from a universal-jointed rod, a chain fall or the hook of a crane, and has the advantage of perfect freedom of movement so that the grinding wheel may be applied to the work in any position and at any desired angle. In Fig. 1 such a machine may be seen in action.

With the increase of power and versatility made possible by the electric motor and the modern abrasive wheel came about the necessity for more adequate support of the wheel arbors. No longer are arbors with pointed centers running in wooden poppets suitable for the purpose, but substantial bearings, well calculated to withstand the strains and provide ample lubrication facilities, must be incorporated into the design of the machine. In the majority of cases the wheel is still mounted between the bearings, but in some classes of work it is necessary to make use of an overhanging arbor with the wheel outside the bearing. This construction, shown in Fig. 2, has the advantage of making it possible to change a wheel without dismounting the arbor.

Many machines are in use wherein the motor is mounted upon a wheeled truck that may be drawn about

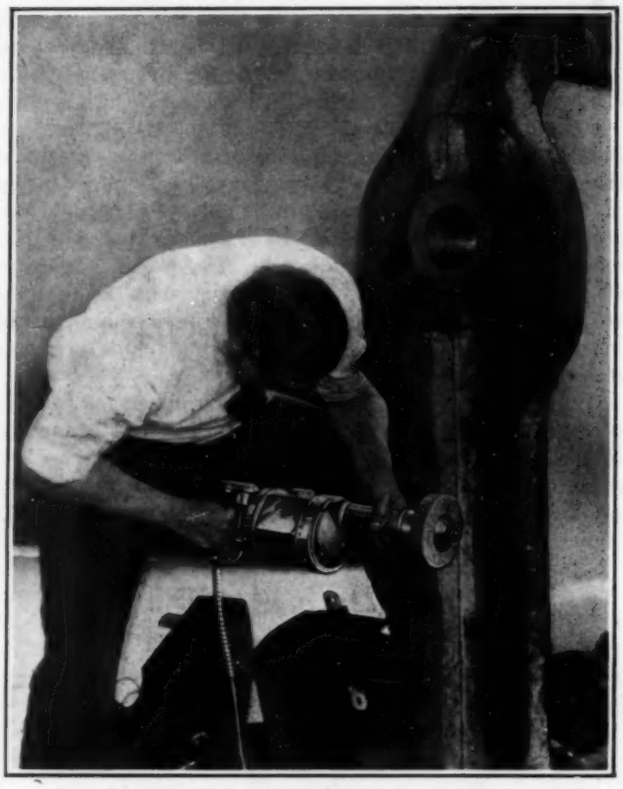


Fig. 4—Application of hand grinder

the shop and attached to any convenient electrical outlet. In this type the wheel head is usually separate and is driven by the motor through some form of flexible shaft. It is applicable to many jobs that require delicacy of manipulation of the grinding wheel without the demand for excessive power, as in the making and repairing of forging dies, where the shapes are such as to render them difficult of access to other kinds of tools. Fig. 3 shows this machine applied to the temporary repair of press tools.

The electric motor is not a necessary adjunct of the flexible shaft machine but is added to increase the portability of the outfit and render it independent of any fixed position. It can be, and often is, driven by belt, in which case the motor is displaced by an arbor mounted in suitable bearings in a fixed bracket which may be bolted to bench, side-wall or ceiling, where it

takes its power from a countershaft or the main line.

The advantage of the electric motor as a driver lies in the fact that the whole outfit may be moved from place to place wherever its services are required and attached by its cord to any convenient electrical outlet. In repairing forging dies the outfit may be wheeled up beside a press, drop or hammer and the repair completed without disturbing the setting of the tools.

Such machines are often used to sharpen press tools in place, a job to which they are even better adapted than are the smaller hand grinders, for the reason that the wheel may be applied in the narrow space between punch and die, whereas the motor frame of the hand machine would prevent its introduction or at least would obstruct the operator's vision. Greater power is available, as the motor may be of any size and the limit of power at the wheel is determined only by the ability of the flexible shaft to convey it, while the power of the hand grinder is restricted by the size and weight of a motor that can be handled conveniently.

Grinding wheels, points and burrs of every conceivable shape are available for use in connection with flexible-shaft machines and it is possible with them to do almost anything to a hardened die or punch that could be done with a file before hardening.

Hand Machines for Light Grinding

The hand grinder is the smallest and most completely portable of the grinding machines, and, as its name implies, is designed to be supported wholly by the hands of the operator. Though there are machines on the market in which a pneumatic engine is the driving force, the hand grinder usually consists of a small electric motor so designed as to get the greatest amount of power into the smallest possible compass. They are available for all light grinding operations to which a portable wheel may be applied. Because their range is limited only by the length of the cord that conveys electrical energy to the motor they may be used in many confined spaces. The larger machines could not be applied because of their size and weight, and the flexible-shaft machine would be ruled out because of the necessity for keeping the shaft clear of obstructions and free from short bends.

In this type of machine, an example of which may be seen in Fig. 4, the shaft of the rotor extends through the motor casing and is fitted with collars and nut to hold the wheel. There are usually but two bearings to support the combined rotor and wheel spindle, one of them being made larger than would be the case if the motor alone were to be considered, and designed to support end as well as radial thrust so that the wheel may be applied to the work in any position. Though burrs and special shapes of wheels may be used on hand grinders, the latter are not so well adapted to the purpose as the flexible-shaft driven wheel head.

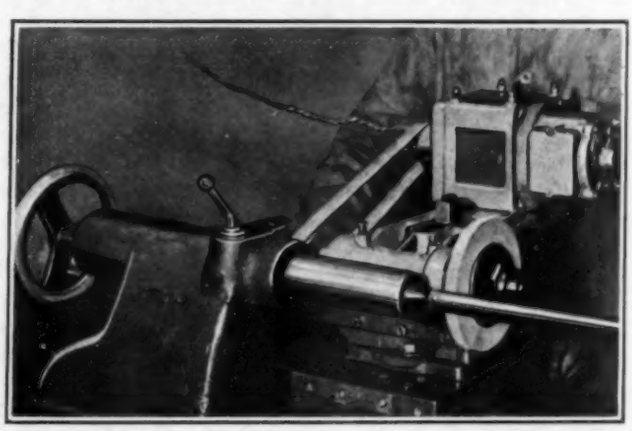


Fig. 5—Grinding a shaft with a "portable" grinder

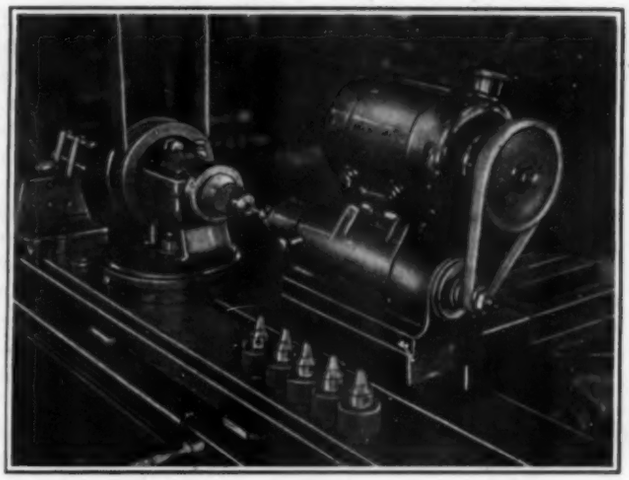


Fig. 6—Portable type of grinder used on wheel-head of standard grinding machine

There is another type of machine commonly called a portable grinder that is not strictly entitled to the designation, for, though the machine itself is easily transportable when not in use, when in service it has become a fixed part of the machine in conjunction with which it is to be used. To this type belong the "toolpost" grinders, adapted to be held in the toolpost of a lathe, shaper or planer, where they become an essential part of what is for the time being a duly constituted cylindrical- or surface-grinding machine. They may be either belt-driven or direct-connected. Fig. 5 shows an example of the belt-driven type.

Toolpost Grinder Used in the Lathe

The toolpost grinder when used in the lathe enables the operator to grind any piece of hardened material that may be held in the lathe-chuck, shafts that may be held on centers, and, in conjunction with the compound-rest, any angle of face that the lathe will produce. A job to which it is particularly adapted and to which it no doubt owes its origin is the grinding of the hardened centers of the lathe itself with the centers in place in the spindle of the lathe. Though toolpost grinders are usually self-contained motor driven machines the wheel may be driven by belt from an overhead drum, or, when intended solely for the purpose of grinding centers, by a flexible shaft having at the end opposite the wheel a rubber disk that is made to bear upon the large step of the lathe cone, from which it is driven by contact.

Used in connection with the shaper or planer the toolpost grinder converts the machine temporarily into a surface grinder and enables it to produce smooth, flat surfaces upon hardened material. The use of the toolpost grinder as above is, however, at best but an expedient, and is not to be recommended except in emergency cases.

Another type of machine, one of which is shown in Fig. 6, is provided with a base to be bolted to the wheel slide of a standard cylindrical grinder, where it displaces the belt-driven, internal grinding attachment of the regular machine. It is entirely self-contained

and is a very satisfactory device for grinding very small internal diameters, as the excessive speed necessary, attainable only with difficulty by the ordinary belt-driven spindle, are easy of accomplishment with this machine.

Most of the grinding wheels used on the swing-frame and the larger of the portable machines are made by the vitrification process for the reason that on the greater part of the jobs, for which such machines are suitable, not only is rapid removal of stock a prime consideration but the method of application demands a maximum of structural strength. There is, however, a rubber-bond wheel made by a process, the details of which have not yet been made public, that claims to rival the productive capacity of the vitrified wheel and to be of even stronger bond.

For small, intricate work, especially forge dies as noted above, where it is important to have a medium that will hold its shape well, wheels of shellac and ordinary rubber bond are generally considered most suitable.

The grade of wheels used upon machines of the swing-frame and large portable type should be relatively harder than those used upon standard cylindrical, surface- and face-grinding machines in which the wheel is rigidly held. A wheel that is used to remove sharp fins and projecting lumps from castings may be as hard as the Norton grade Z, while for broad, smooth surfaces grades M to P are most suitable. Rarely are wheels softer than grade M used.

Difficulties from Wheel Wear

Rapid removal of stock is usually the prime requisite and for that reason the coarser grains of abrasive are extensively used, though it is quite possible to use a wheel of too coarse grain, even upon this work. Because of the uneven surfaces to which they are applied and the lack of rigidity due to the method of application, the wheels tend to wear out of round rapidly. While true concentricity is not so essential as in the more precise work of machine grinding, the more a wheel is out of round the more rapidly will it tend to increase its eccentriicty and waste its substance in useless bumping over the surface of the work. Further, a badly balanced wheel is difficult to hold up to its work and the strain upon the operator soon becomes excessive.

Other things being equal, a coarse-grained wheel tends to break down and change its shape more rapidly than does one of finer grain, and therefore it is sometimes advisable to change to a wheel of finer grain rather than to one of harder bond when trouble of this nature is encountered.

Owing to the nature of the machine it is not practicable to use a diamond to dress the wheels, and because true concentricity is not so important, the diamond is not necessary. There are several types of wheel dressers available for the purpose, some of them having star-shaped disks or grooved rollers of hardened steel, others being composed of round bars of abrasive and bond, molded inside a metal tube and provided with a handle.

Another dresser is a small abrasive wheel mounted to turn freely upon a short axle that is provided with knobs at the ends so that it may be grasped in the hands of an operator. In action the small wheel is pressed against the larger one and is driven at full speed by the frictional contact. The axis of the small wheel is held at an angle to that of the larger one, thus setting up a sidewise pressure that tends to break down the dulled particles of abrasive and tear them loose from the bond.

One dresser that is much used on snagging wheels is a "brick" of abrasive and bond made for the purpose, or perhaps a section of a broken wheel. By holding this brick against the revolving grinding wheel and letting the latter drag over it, the particles of abrasive are torn from the bond of the grinding wheel and new sharp facets presented. This form of dresser is quite effective when the desired result is to sharpen the wheel. As a wheel *truing* device it leaves much to be desired.

Measuring Internal Stress in Tubes

In a paper read at the September meeting of the Institute of Metals, London, R. J. Anderson, consulting metallurgical engineer, Boston, and E. J. Fahlman, Superintendent of the National Smelting Co., Cleveland, described a new method of determining the existence and magnitude of internal stresses in cold-drawn tubes. The material was what is known as "leaded 2 to 1 mixture," cold-drawn brass tubing, the nominal composition being 66.33 copper, 33.17 brass, 0.5 lead.

The ordinary tests by a chemical accelerating cracking agent (a mercury-salt solution or ammonia); by turning off concentric layers in a lathe and measuring for changes in length; and by cutting diametral rings failed to show any indication of internal stress. As the reduction of area had been from 17 to 56 per cent it was believed that internal stresses must exist.

The test used consisted of making two longitudinal cuts with a thin milling cutter leaving 0.10 in. of metal between. A short transverse cut released one end of the strip and allowed it to spring outward if internal stress existed, as it did in each case. The specimens were annealed by heating at 325 deg. C. for 2½ hours and similar cuts were made on the opposite side of each tube. The amount of springing out of the second strip was much less than that of the first, indicating relief of stress. In addition it was noted that the spring of the original strips was increased by heating.

A formula for calculating the amount of stress in lb. per sq.in. was worked out. Its application showed the desirability of heat treatment as the stress was greatly reduced with but little accompanying reduction in Brinell hardness. The formula is $S = \frac{t E i}{l^2}$, where $S =$ stress in lb. per sq.in., $t =$ thickness of tube wall in in., $E =$ modulus of elasticity of the material, $i =$ amount of springing out in in., and $l =$ length of cut strip in inches.

As regards their procedure the authors have this to say:

"The cold-worked tubing to be treated is cut into lengths, and the original stress determined by cutting a strip on one side of the samples. The test-pieces are then heat-treated, and the stress determined by cutting a strip in the side opposite to the first strip. The variation in stress around the wall of a tube may be tested by cutting strips at intervals. It might be asked if cutting a strip in a tube would not largely release the stress throughout the sample, so that cutting a second strip on the opposite side would not give the stress at the second position. It is regarded as experimentally proved that there is substantially no release of stress in other portions of a tube by cutting a strip in one portion."

Methods of Machine Tool Design

By A. L. DeLeeuw
Consulting Editor, *American Machinist*

Consideration of the machine framework as a support for slide-ways—Wear of sliding surfaces under various conditions—Effect of an oil film between surfaces

GENERALLY speaking, the framework of a machine is called upon for various duties. In the first place, it must support the vital parts, and attention is once more called to the necessity of designing these vital parts first and working the frame around them, rather than what is done occasionally—designing the frame and attempting to get the vital parts inside. A second very important duty of the framework is to contain the slide-ways and bearings for the various moving parts. A third equally essential duty of the frame is to provide a foundation upon which the moving parts can rest and move without disturbing the alignment.

The first and third requirements have been discussed, and we will now look at the framework of the machine from the standpoint of its value as a support for the slide-ways. The slide-ways for machine tools are so absolutely essential to the machine that they deserve special consideration. They must be very accurate and they must wear very little. If they do wear they should wear evenly, and the wear should not disturb the alignment of the machine more than is absolutely unavoidable. Finally, means should be provided to compensate as much as possible for whatever wear there may be.

There is a misconception floating around in the minds of a good many people that if one should make the slide and its ways of equal surface, there would be no wear. Others seem to think that there would be wear but that it would be a minimum. Still others that there will be wear but that it will be even, so that there is practically no disturbance of the alignment. All these ideas are based on an assertion that Professor Sweet once made, that where two surfaces rub together they should be of even length to obtain a minimum of disturbance of the alignment. So far as the writer knows, Professor Sweet was referring to the guides for a steam engine. Conditions in a machine tool are different and, though the rule is a good one to remember, it is not a good one to apply to machine tools without careful consideration of each individual case.

In the diagram at the top of Fig. 239 is shown a table that can slide on a saddle. The table is supposed to be 24 in. long, the saddle is of the same length, and the movement of the table is 8 in. on either side of the saddle. The diagram immediately below indicates the amount of wear which we may expect at various points of the saddle. In each horizontal line the cross-hatched parts indicate the part of the surface which is not wearing. For instance, the top row represents the table in the central position and, since the table is moving, there will be some wear at every point of its lower surface. There are 24 in. of length to support the weight and whatever other pressure there may be,

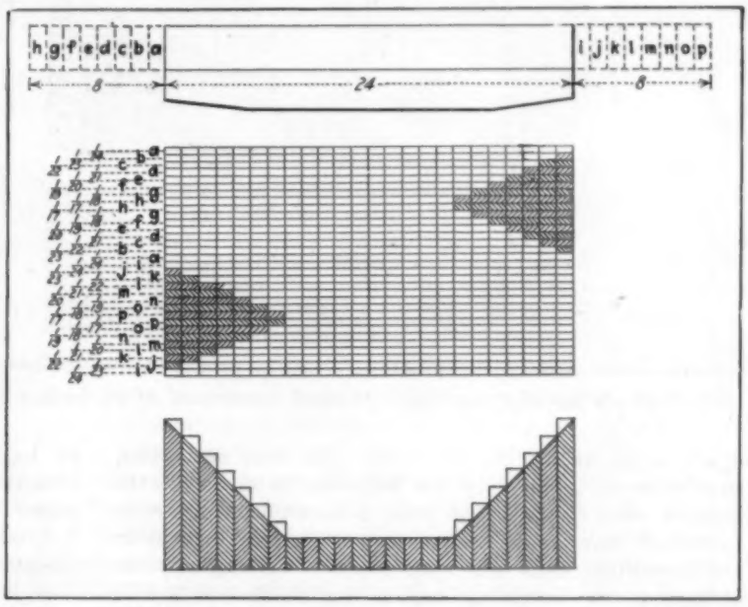


Fig. 239—Diagram showing wear of table and saddle with equal movement each side of center

the unit pressure being $\frac{1}{24}$ of the entire amount. The next row *b* shows the conditions when the table has moved 1 in. to the left. The last inch at the right of the saddle does not wear because the table no longer rests upon it. The other 23 in. of the saddle do wear, and this wear may be expressed by $\frac{1}{23}$ per unit of area. In the third horizontal row there will be 2 in. which are not subjected to wear and 22 in. that are wearing, each of which is subjected to $\frac{1}{22}$ per unit. This diagram is carried out until we reach *h*, a point where the wear is $\frac{1}{17}$ per unit. At this point the table begins to return and we will shortly be back in the same condition as when starting. However, the table keeps on moving from left to right, and the lower part of the diagram will show the parts of the surface not subject to wear on the left side of the saddle.

The third part of the diagram shows the points which may be expected to wear and those which may be expected to be left standing. If there were nothing to

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prevent such a condition, the saddle would take the shape indicated by the top line of this lower diagram. Of course the depth of this wear would not be as great as shown here, but the configuration would correspond to the nature of this outline. However, it is of course, utterly impossible for the ends to remain standing while the center is worn away unless the part which slides in it should have a rocking motion. We can imagine the table to be convex and the saddle to be concave, but we cannot imagine the saddle to be concave while at the same time the table is straight, because as soon as such a condition existed the high points of the saddle would wear away and we would no longer have the conditions shown in the diagram.

The same conditions which would make the saddle concave would also make the table concave, and this

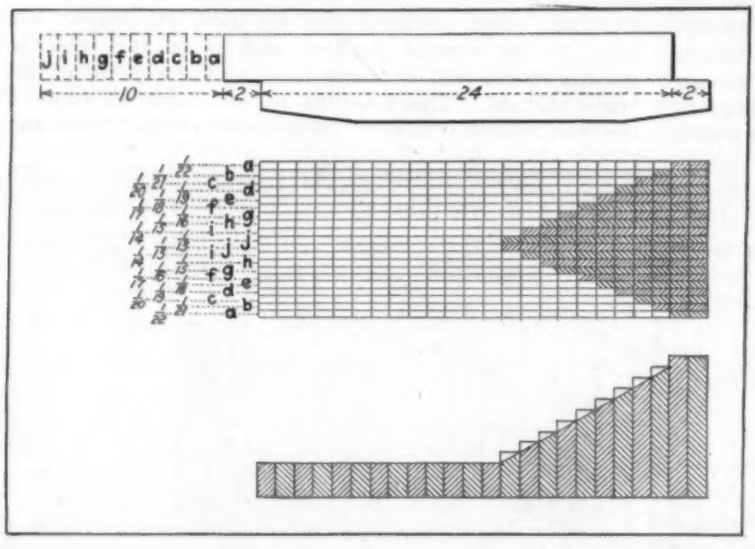


Fig. 240—Wear diagram for left-hand movement of 10 inches

again is an impossible condition. We may say, then, that there is a tendency for both saddle and table to become concave, but that such a result can never be produced, because as soon as any hollow is formed in the center the ends will wear away. We may express this in a few words by saying that table and saddle correct each other under the conditions which we have assumed. These conditions were, in the first place, that the lengths of the two parts were equal; in the second place, that the movement of the table was equal to the right and left of the center; and in the third place, that the load remained uniform during each stroke. When these last two conditions are fulfilled, the two equal bearing surfaces will remain flat, and the wear of the two will not affect the direction of the motion. This conditon is somewhat modified if the metal of either of the two parts is not homogeneous.

When we have a condition such as shown in Fig. 240, the conclusions reached in the previous paragraphs are no longer correct. In this illustration we again have a table and saddle both 24 in. long, but the initial position of the table is 2 in. to the left in relation to the saddle. It is supposed to make a movement of 10 in. to the left and then back again. The upper row *a* in the second part of the diagram shows that 22 out of the 24 in. of the saddle are subjected to wear, each with a unit pressure equal to $\frac{1}{11}$. In the second row *b* there are 21 in. subject to wear, each with a unit pressure of $\frac{1}{11}$, etc. The cross-hatched portion represents that part which is not subject to wear during the various positions of the table on the saddle, and in the third part of the diagram the result is shown on the configuration of the saddle when wear has taken place. This last portion of the diagram shows that the 2 in. at the extreme right are not affected at all; that the next inch is slightly worn away; the next inch a little more, and so on, the last 13 in. having a maximum wear that is uniform if there are no other conditions than those mentioned. However, the table wears in a similar manner except that, in this case, the extreme right end of the table wears more than that portion further to the left, and the last 2 in. to the left do not wear at all.

The actual result of such a set of conditions is that the table wears concave, the saddle also wears concave, and the two will modify each other until the table has a rocking motion on the saddle. That this amount of rocking would be exceedingly small has no bearing on our present considerations. We can see that there is a tendency to produce such a rocking motion and that a shoulder will be formed 2 in. from the right end of the saddle and 2 in. from the left end of the table.

The diagram in Fig. 241 also shows a saddle and table of equal length and 24 in. long, but this time the table has a movement of 6 in. to the right and 10 in. to the left. Following the same method of analysis we find that the saddle will wear most in the center, somewhat less on the left, and still less on the right. The table would try to follow this configuration and again we would have a concave saddle and table, but this time the curves are not central. In other words, there is not only a rocking motion of the table on the saddle, but there is also a greater drop on the left end of the table than on the right. Such movements as the ones we have described here are not perceptible, but the final results are well known to men who have run machines under heavy duty. They do not show up the first minute or even the first day, but they are easily recognized after the machine has been in action for a considerable length of time.

The foregoing diagrams and discussion show that the mere fact that we have equal bearing surfaces does not insure against loss of alignment, and certainly not against wear. The shoe of a crosshead and the guide bar on which it moves should be of equal lengths because this arrangement will maintain alignment and reduce the wear to a minimum. However, in the case of a crosshead and its guide we are dealing with a machine in which the stroke is always the same, whereas in machine tools the stroke varies, at least as a rule. It is therefore no longer permissible to take this nice easy rule of equal surfaces as a final solution for all of our troubles. Mechanics, realizing that they could not have equal surfaces in such cases as a lathe or other machine of this type, have still been apt to insist that equal surfaces would be the best construction for the table and saddle of a milling machine or for the table and bed of a planer. We have now seen that the variable strokes to which these machines are subjected make this rule inoperative.

Until now we have assumed that the two parts were of the same kind of material. If there is a difference in hardness, or rather, in wearing qualities of the ma-

terials of the two parts, the conditions will be somewhat different from those shown in the three diagrams. If, for instance, the table were softer than the saddle, there should still be some wear in the saddle, but the material left standing at the ends would rapidly wear away the softer material of the table and we would get a more pronounced rocking effect. We might even get this rocking effect when the conditions are as shown in the first diagram, that is, with a symmetrical motion.

In most machine tools operations are performed in a variety of positions but, as a rule, there is one region of the machine in which more work is done than in others. In a lathe, for instance, more work is done near the headstock than at any other part of the bed. In a planer most of the work is done at the central part of the table and when the table is central on the bed. With a shaper most of the work is done when the ram is well back, and with a slotter when the ram is well down. Consequently, there cannot be the same amount of wear at the various points of the supporting slideway. There is perhaps no class of machinery in which this feature shows up to such an extent as in the lathe, and especially in a long lathe. As a rule long lathes are used for a very large percentage of the time on medium and short work. It is but seldom that a long lathe is used all the time on long work. It therefore happens quite frequently that the ways of a long lathe are worn considerably at the headstock end, remaining almost as good as new at the tailstock end.

In machines where a short member slides over a long one it is good policy to make the short member of softer material. In some modern lathes the Vees are chilled and, in some cases, hardened pieces are laid in, whereas the carriage is made of an ordinary grade of cast iron. Under these conditions practically all of the wear comes on the carriage and the ways of the bed are affected very little for a long time. This method of using harder material for the long slide-ways cannot well be used in the planer, but it is just as essential, if not more so, to have planer ways wear evenly as it is to have lathe ways wear evenly. If the lathe ways have worn at some spot, the carriage will drop there, but a certain amount of drop of the carriage does not produce a corresponding amount of error in the work. If, on the other hand, the planer ways have worn at some spot, the amount of error produced in the work will be just as much as the drop in the ways.

Until now we have assumed that the contact between slide and slide-ways was metal to metal. This is almost so in the case of the lathe, particularly if the carriage rests on Vees. In the planer, however, a definite attempt is made to introduce an oil film between the two surfaces and the existence of such an oil film modifies conditions very materially. It may therefore be well, before going on, to consider somewhat more in detail the effect of an oil film on the wear of machine parts.

Oil being a liquid, it is quite natural to think of it as not being capable of supporting the weight of a heavy piece of iron. When we think of a liquid supporting a solid we naturally think more or less of a piece of wood floating on water. If the specific weight of the piece is less than that of the liquid, it will float; if not, it will sink. The specific weight of iron being greater than that of oil, our first impression will naturally be that the oil cannot possibly support the iron. This conception, however, is wrong. It is almost right when the thickness of the film of liquid is considerable, but it is not right at all when this thickness is very small. We may imagine a perfectly flat surface laid down perfectly level and a drop of oil placed on this surface. We will see that this drop assumes a certain shape. It flattens itself, but it retains a considerable thickness in the center. It does not spread itself over the entire surface of the piece of iron.

We know that if a drop of oil is released and left to fall, it will assume the shape of a sphere—not quite, but nearly so. If there were no force of gravitation to exert a pull on it, the shape would be a perfect sphere. This is due to the fact that there is a considerable force of

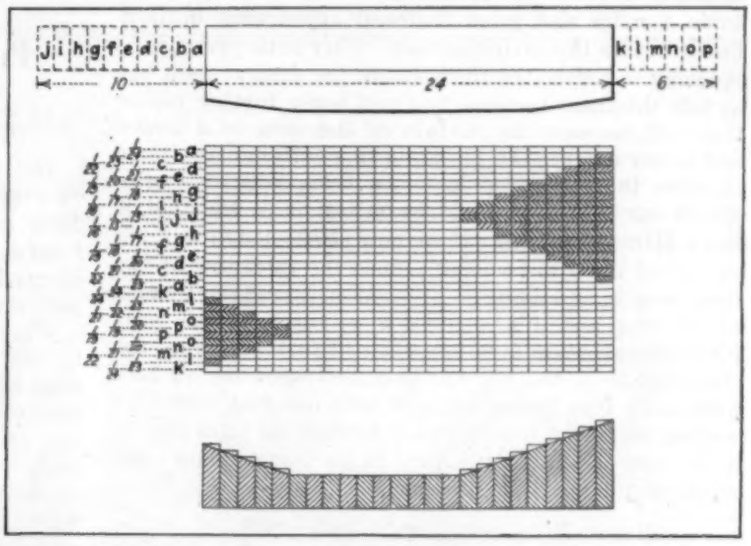


Fig. 241—Wear diagram for left-hand movement of 10 in. and right-hand movement of 6 inches

attraction between the particles of the drop of oil. Inside of the drop these forces neutralize each other A particle of the drop which is attracted to the left by a neighboring particle will also be attracted to the right by another particle. Out at the surface there is an attraction from an inner particle, but there is no particle on the other side to counteract this effect. All outer particles are therefore attracted toward the center and, if there is no disturbing force at work, the little drop of oil is bound to take the shape of a sphere. When such a drop is placed on a piece of iron it will also tend to take the form of a sphere, but, at its lower surface, there is the iron to attract the particles at the lower half of the little drop. As a result, the form of the drop will be changed and it will be flattened. How much it will be flattened depends on the attraction between the particles of oil, as well as the attraction between the particles of oil and the particles of iron.

The shape which the drop will finally assume depends upon the point where equilibrium is reached between the forces at work—the weight of the oil, the surface tension of the oil (this is the unbalanced attraction of the particles of oil), and the attraction between iron and oil. If by some means or other, we should gather the oil from the edges and bring it up to the center of the drop, thus making this drop higher, it would at once assume its former shape as soon as the outside force is removed. If, by some means or other, we could depress

the little drop but without removing any of the oil, it would at once come back to the original higher shape as soon as the pressure ceased. This surface tension is different for various kinds of oil, but is considerable in all cases. It is a force which tries to counteract all attempt at distorting the mass of oil. As soon as any attempt is made to give the mass of oil a larger surface, the surface tension of the oil causes a resistance against this attempt. As a result, it requires a certain amount of pressure to flatten out a drop of oil into a film.

We can imagine that a drop of oil is placed on a piece of iron and that we carefully place a thin sheet of glass perfectly parallel with the iron and on top of the drop of oil. The weight of this thin piece of glass will then depress the drop and spread it out over a larger surface. We can imagine that we then put weights on the piece of glass, and we will gradually see the drop of oil assume a more and more flattened appearance until it finally covers the entire surface. Very little pressure is required to reduce the thickness of the drop at first, but as this thickness becomes less and less a further reduction will increase the surface of the drop to a larger and larger extent. To illustrate this with figures, let us imagine that the drop is $\frac{1}{16}$ in. thick when we have placed our thin piece of glass on top of it, and that it has a diameter of $\frac{1}{4}$ in. If we now place enough weights on top of the glass we can reduce the thickness of the drop to $\frac{1}{32}$ in. In doing so we have increased the surface of the drop and this required a weight *P*. If we next place enough weights on the glass to further reduce the thickness to $\frac{1}{64}$ in., we will have increased the surface practically four times, whereas with our first reduction we had increased it only twice, so that the total weight must now be approximately three times what was required for our first development.

Heavy Pressure Carried by Thin Film

If we go still further and place enough weight on the glass to reduce the thickness to $\frac{1}{128}$ in., we will have increased the surface approximately eight times its original amount, so that the additional weight will have to be 7*P*. If we should increase the weights until we have reached a thickness of film of 0.001 in., we would have to put on about 3,600*P* and, if the thickness of the final film is 0.0001 in., the weight would have to be approximately 36,000*P*. It should be kept in mind that these figures are crude approximations, yet they illustrate the fact that it is easy to reduce the drop of oil when it is still thick but very difficult to reduce it further when it is thin; and it shows that this is caused by the surface tension.

Not only does it require considerable pressure to flatten a drop of oil, but when it is so flattened it will resist attempts to squeeze it out between the two surfaces by the sudden application of a great force. This is important in the application of oil to machine parts, especially in machine tools. Two surfaces may be separated by a thin film of oil, but a sudden blow or shock which produces a unit pressure much greater than that ordinarily experienced might at once squeeze the oil out from between the surfaces and thus leave a metal to metal contact. A little consideration, however, will show that this cannot be so.

Let us imagine two perfectly flat surfaces each 6x6 in., and a film of oil 0.0001 in. thick between them. Let us further imagine that the pressure on the top piece is such that the entire system is in equilibrium. We now apply a sudden great force or pressure to the top piece. In order for the film to be squeezed out, the following must happen: The top piece must approach the bottom piece through a distance of 0.0001 in., so that the volume of oil to be squeezed out is 0.0036 cu.in. This oil must flow out through the opening left between the plates, this opening having a length of 24 in. and a width of 0.0001 in. If the upper plate were moving downward at the rate of 1 in. per sec., 36 cu.in. of oil would have to be squeezed out in one second through an opening having an area of 0.0024 sq.in. The speed of the oil emerging from the narrow opening between the two plates under these conditions is 15,000 times as great as that with which the upper plate moves. The resistance of the oil against further flattening—surface tension—is therefore multiplied by 15,000 when it resists the movement of the upper plate under the effect of a blow or shock.

Pertinent Ideas on the Cutting of Threads—Discussion

By A. R. Nottingham

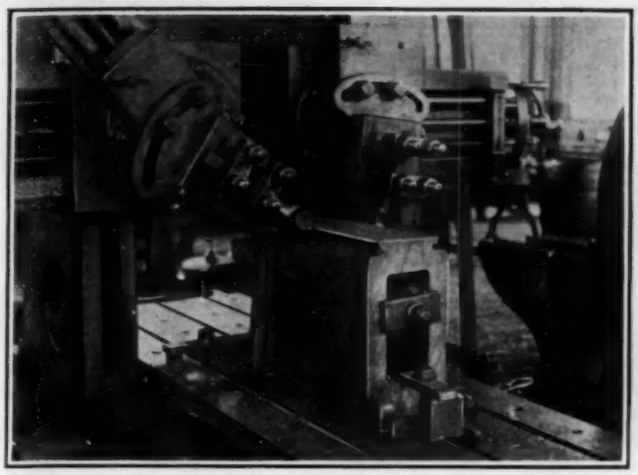
The article under the above title by H. R. Fowler on page 573, Vol. 60, of the *American Machinist*, gives many good reasons for the use of larger tap drills and I agree, in the main, with this and other similar recent discussions. There is, however, one phase of the subject which should be kept in mind.

While it is true that a 50 per cent engagement of thread, even in soft metal, will break the stud when done as a laboratory test, the nut is often a loose fit on the truncated thread in practice and the thread forms are often far from perfect. When the machine has been overhauled several times the nuts are usually ready to strip the threads, and studs will also loosen when the machine is subject to heavy vibration and abuse in service.

Many shops have not given enough attention to the flow of the metal. It has been my practice when full V-threads are required for steam work, to turn a male piece of 1 in. nominal diameter nearly $\frac{1}{32}$ in. small. This is necessary when heavy cuts are taken in soft steel. Likewise, in certain soft steel forgings the holes should be about three sizes larger than shown in the tables for a $\frac{1}{2}$-in. pipe tap. If only two sizes larger are used the tap has to be worked in to depth with an extreme care that is not to be considered in commercial manufacture. The same is true of U.S.S. and S.A.E. threads, but to a more limited extent. All ductile metal will flow if the pressure from dull taps and dies is great enough.

Now that the thread standards have been overhauled, we need to tabulate about three drill sizes for, say, 50 to 75 per cent ideal engagement. If there is no existing size sufficiently close, the exact size should be given and marked with a star. Such tables will be made if there is sufficient demand.

It is certain that in many cases a 50 per cent drilled hole will give a much higher tapped engagement. The actual engagement should be from 70 to 85 per cent, except for a fluid-tight joint in the thread. These sizes, however, must be chosen with good engineering judgment. The above drills will give 70 to 85 per cent engagement in ductile metals, according to the metal tapped. These can be tabulated, giving the ideal and actual engagement for different metals and tempers. The above are for machine fits, and for pressure work a fourth size should be added to give full engagement.

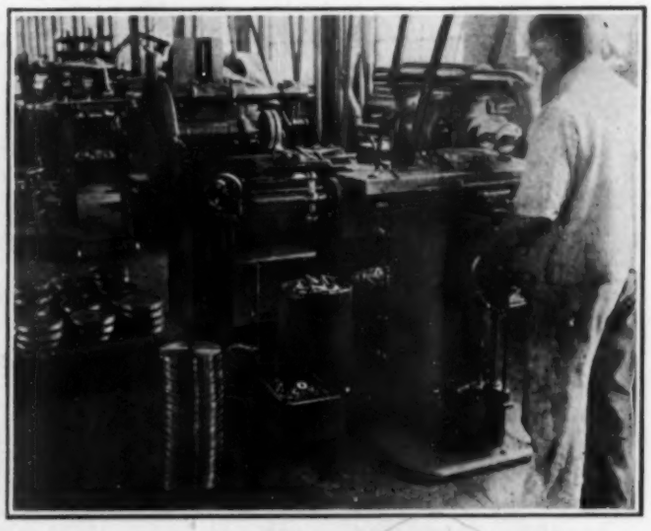


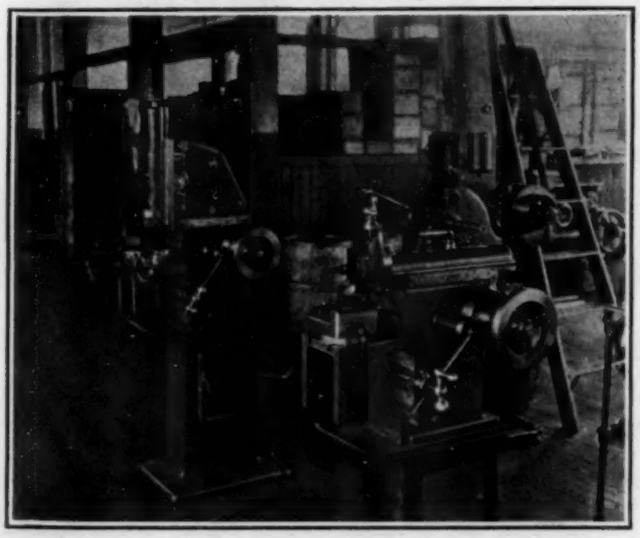
Where Machine Tools Are Made

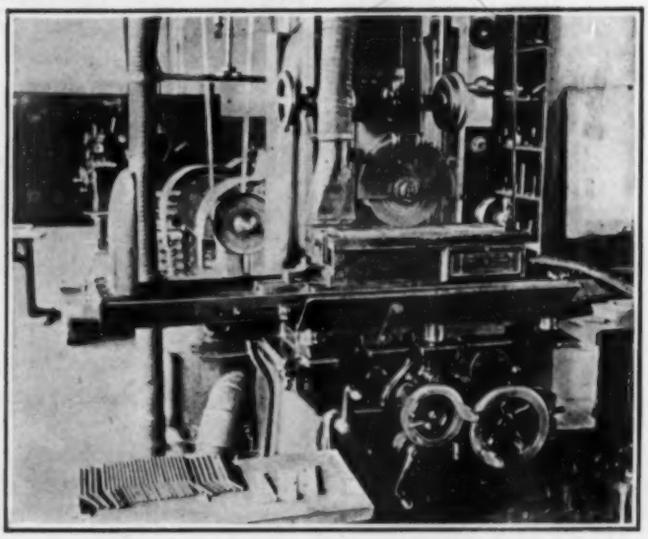
Rhodes Manufacturing Company

Hartford, Conn.

Established 1912

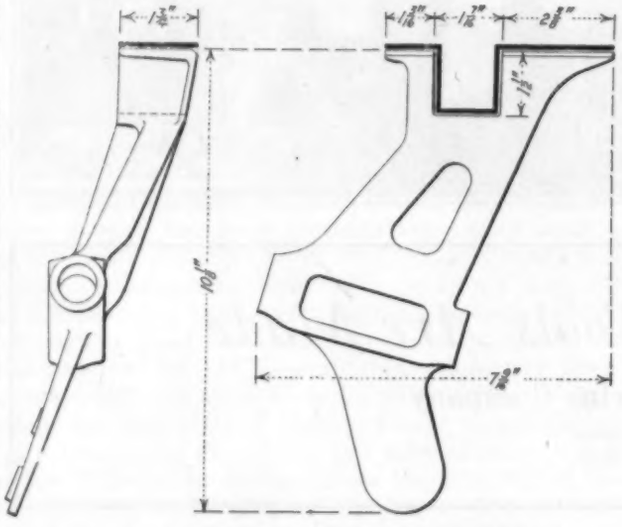




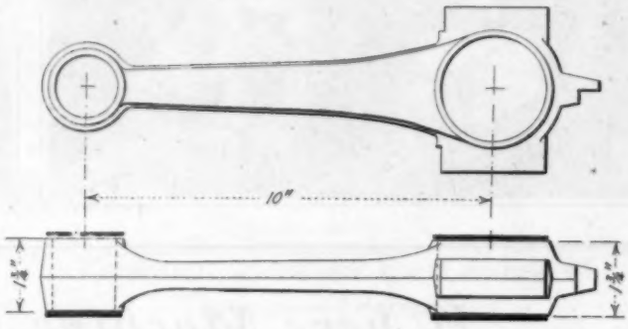


What Modern Machine Tools Are Doing

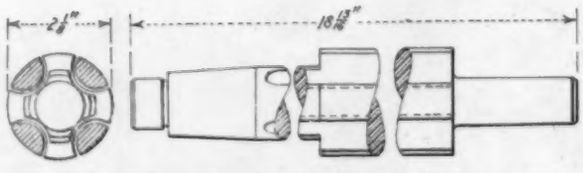
Cincinnati Milling Machines



Windshield bracket. Malleable iron. Mill face and slot. Hand-index fixture, holds two pieces on each end. Four 4½-in. and two 7-in. cutters. Speed, 53 r.p.m. Feed, 4⅜ in. per min. Stock removed, ⅛ in. Pieces per hr., 78. 48-in. plain automatic.

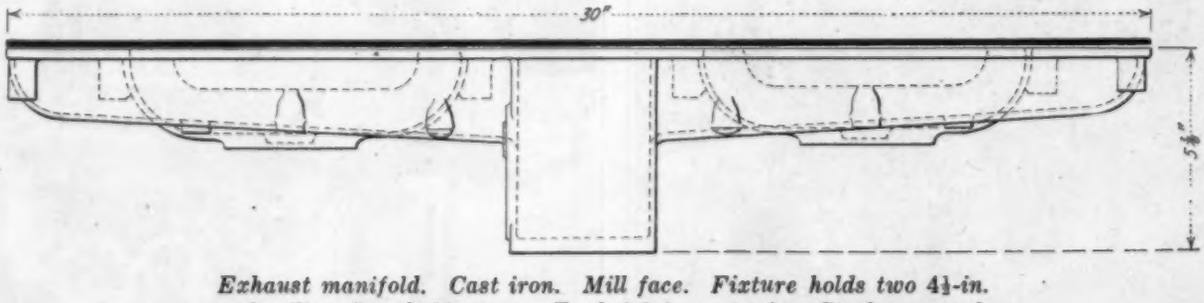


Connecting rod. Drop forging. Mill bosses to length. Index base, two rods in vertical position at each end. Both ends milled at one pass. Four 7½-in. cutters on upper arbor and four 11-in. cutters on lower arbor. Speeds, 38 and 24 r.p.m. Feed, 3½ in. per min. Stock removed, 1/32 in. to ⅛ in. Pieces per hr., 78. 48-in. duplex automatic.



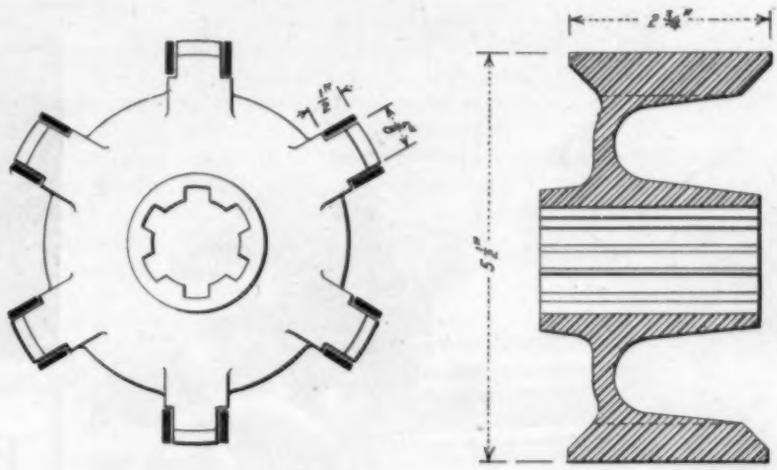
Transmission shaft. Forging. Form-mill grooves. Two-spindle, hand-indexed fixture, milling under and over. Four 4½-in. form cutters. Speed, 53 r.p.m. Feed, 5⅜ in. per min. Stock removed, ⅛ in. Pieces per hr., 19. 48-in. duplex automatic.

Front axle. Forging. Mill edges of spring pads. Hand-index base with universal fixture. Two 6-in. face mills. Speed, 53 r.p.m. Feed, 9⅛ in. on small axle, 5⅜ in. on large. Stock removed, ⅛ to ¼ in. Time per piece: small, 5.3 min.; large, 8.9 min. 48-in. worm-drive duplex automatic.

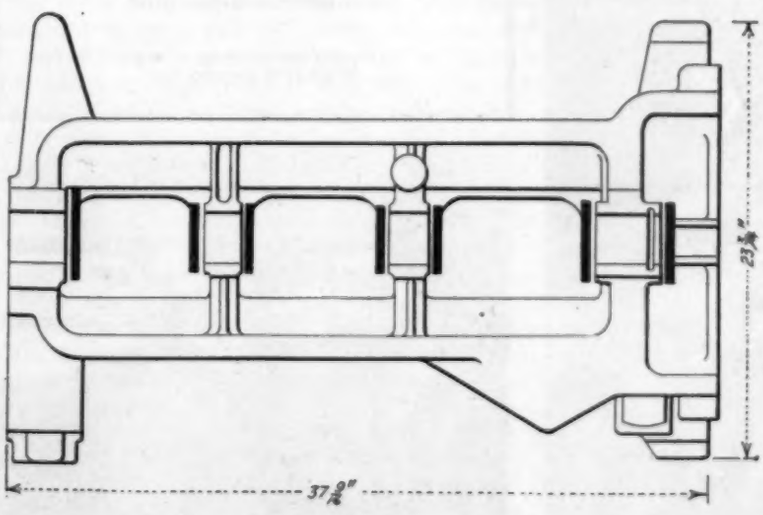


Exhaust manifold. Cast iron. Mill face. Fixture holds two 4½-in. end mills. Speed, 66 r.p.m. Feed, 8.3 in. per min. Stock removed, ⅛ to ⅛ in. Time per piece, 2.2 min. 24-in. duplex automatic.

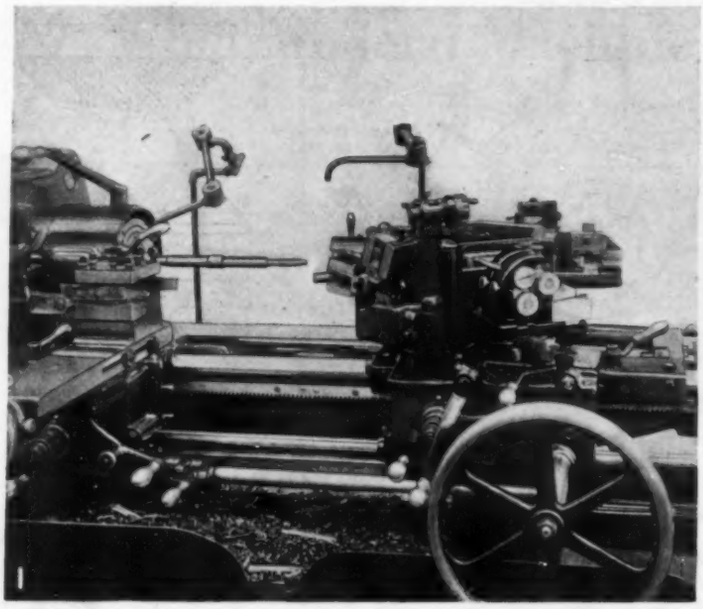
Clutch hub. Steel forging. Mill sides of splines. Two-spindle head, automatic indexing, holds two each. Eight 4½-in. half side-mills. Speed, 75 r.p.m. Feed, 5⅝ in. per min. Stock removed, ⅛ to 5/32 in. Prices per hr., 47. 48-in. worm-driven duplex automatic.

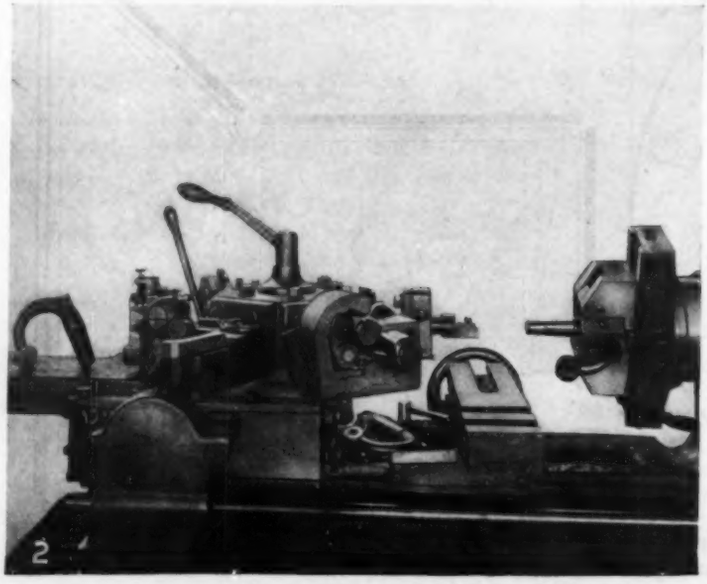


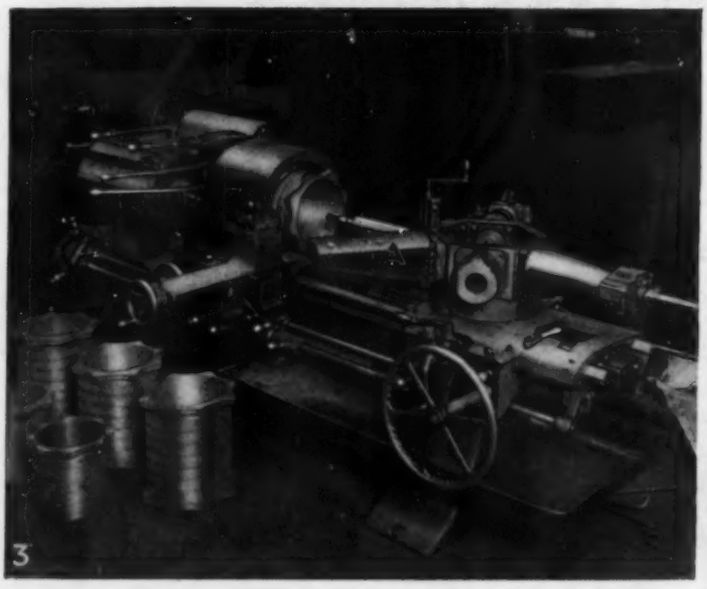
Transmission case. Cast iron. Mill face and end. Special fixture. One 9½-in. and two 6-in. face mills. Speeds, 28 and 44 r.p.m. Feed, 11¾ in. per min. Stock removed, ⅛ to 7/32 in. Pieces per hr., 38. No. 4 plain machine.

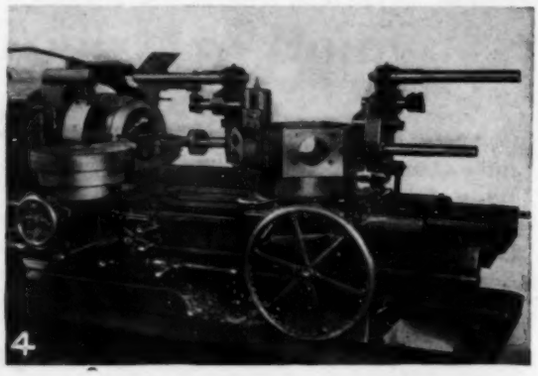


Crankcase. Aluminum. Mill sides of bearings. Seven 5-in. half side-mills. Speed, 157 r.p.m. Feed, 7½ in. per min. Stock removed, ⅛ in. Pieces per hr., 60. 48-in. plain automatic.









Five Turret-Lathe Set-Ups

Fig. 1—Motor shaft. Machine both ends at one set-up, using tools in cross slide for turning end next to chuck. 24-in. machine. Time, 7 min. each

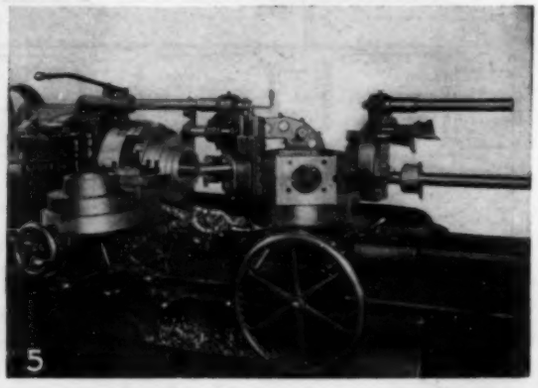
Fig. 2—Turning taper end of steering knuckle. Special chuck jaws. Taper turned by circular form-tool in roller rest. Cross slide not used

Fig. 3—Boring large cylinder. Roughing and finishing boring bars with pilots. Small hole reamed in end. Note support *A* for holding cylinder while being chucked and removed

Fig. 4—First chucking of commutator shell. Two specially piloted tools in turret. Tools in cross slide

Fig. 5—Second operation with commutator reversed in chuck. Same type of pilots. Turning with cross slide and turret tools. 3-A universal machine

Photos by courtesy of the Warner & Swasey Co.



Notes on Welders' Safety Glasses and Accessories

W. S. ANDREWS
Consulting engineer, the General Electric Co.

IT IS well known that the human eye is more sensitive to yellow and yellow-green light (wave lengths 5500—5700 A) than it is to light in other parts of the spectrum. As the intense glare of the iron arc produced in welding operations practically covers the entire visible spectrum, it is evident that to insure the clearest definition of the work in hand, with the least possible amount of radiant energy and eye strain, a safety glass should transmit all of the yellow and yellow-green light rays and exclude the others. Unfortunately, it does not seem possible to make a colored glass that will meet these requirements exactly, for the spectra of all the safety glasses now on the market show a good fringe of orange and red on one side of the yellow, and, in most cases, a fringe of green on the other side of it. When this extra transparency is not too marked, however, it does not make the glass unacceptable.

The color of a safety glass, especially when observed by the unaided eye, naturally depends largely on the source of illumination, so the Bureau of Standards advises the use of a 200-watt, gas filled, tungsten filament lamp, operated at normal voltage, for the examination of these glasses. With this source of illumination, the general tint of a dark safety glass should be a brown or brownish green. If the brown is inclined to red, it is an indication that the glass transmits too much red light. Unaided visual observation of color, however, cannot be safely relied upon, for the true analysis of a compound color can only be made by a spectroscope.

Under spectroscopic observation with the above source of light, a dark safety lens should transmit light consisting principally of wave lengths from 5300 A to 6300 A without any practically noticeable absorption bands within these limits. Several of the safety glasses now on the market conform substantially with these conditions.

DEVELOPING DOMESTIC GLASSES

Before the war, we were largely dependent on the foreign market for welders' safety glasses, and when this source of supply was cut off, we had to invent many makeshifts, as our home manufacturers had not then developed satisfactory substitutes. Various shades of home made ruby, yellow, green and blue glasses were combined to get a suitable density of color, with more or less success, but the building up of plate on plate for this purpose necessarily resulted in an undesirable weight of material, thus making helmets and shields cumbersome and tiresome to handle. Hundreds of screens were made in our company by packing colored gelatin and celluloid between two plates of clear glass, and excellent results were thus obtained as far as the transmission of light was concerned. Unfortunately, however, these screens deteriorated fast under the influence of the intense light and heat rays produced by the iron arc, so that their life was generally short. They served a useful purpose, however, when it was impossible to get more satisfactory substitutes.

In addition to transparency, or the transmission of visible light, glass also has the property of diathermancy or ability to transmit invisible heat rays. Glasses of different compositions, although their color densities may be alike, may vary in this respect from 2 per cent to 25 per cent. The National Safety Code, issued by the Bureau of Standards, does not attach much importance to this quality, but, other features being equal, preference should be given to the glass that shows the lowest degree of transmission of heat rays. It is the opinion of some ophthalmologists who rank high in their profession, that continuous exposure of the eyes to heat rays may produce very serious injury, as evidenced in the disease known as "glass-blower's cataract." The small gas jets used by glass blowers produce but little visible light, but are high in heat rays, which are believed to be responsible for the disease in question, as it is not customary for glass blowers to use protective screens.

DANGERS OF ULTRA-VIOLET RAYS

Ultra-violet light beginning at a wave length of 3050 A produces a destructive effect on living animal tissue especially when generated from such an intense source as the iron welding arc. It is therefore a fortunate provision of nature that any ordinary glass of reasonable thickness provides a complete protection to the eyes, as these rays are almost entirely excluded thereby. There is a tendency in some kinds of blue and violet glass to transmit ultra-violet rays, so it is desirable to avoid such glasses excepting for special purposes. Clear window glass absorbs these rays better than blue glass, but dark brown and brown-green safety glasses are thoroughly effective in this respect. It must be carefully remembered in connection with spectacle lenses that the so-called "pebble" lenses are made of clear quartz or natural rock crystal, and this material, being transparent to ultra-violet rays, offers no protection against their harmful features.

It goes without saying that no kind of structural defects are allowable in safety glasses. All lenses should be carefully inspected and only those should be passed that are substantially free from striæ, air bubbles, streaks and other flaws. Also all cover glasses should be renewed as soon as they become spotted or dull.

The first inspection of a safety glass should be made with the aid of a spectroscope. If found satisfactory, it then remains for the operator to select the shade or density of color that is best suited for his own particular sight and work. Acuity of vision varies considerably in different individuals, so that a man who has very good sight may get clear definition of his work with a glass that would be too dark for one whose eyes may not be so keen.

In order to protect the eyes as much as possible, the darkest shade that shows a clear definition without any strain should always be selected. If an operator uses spectacles or eye glasses in his ordinary work, they should not be discarded when he puts on his helmet or takes up his hand shield. When an operator can see his work clearly without feeling any strain or discomfort in his eyes, he may feel assured that they are safe from injury. It should not be forgotten, however, that too much light or glare may be quite as injurious as too little light, as the eye strain and unpleasant sensations in the eyes may be provoked in both cases.

Ordinary whitewash, made with lime, reflects a considerable amount of ultra-violet light. It is therefore desirable to paint the walls of an arc welding shop with a non-reflective paint.

From data furnished to the American Bureau of Welding in connection with its research information service.

Summarizing the effective means for eye protection in arc welding work:

1. The intense glare and flickering of the arc should be softened and toned down by suitable colored glasses, selected by an expert, and having a depth of coloration which shows the clearest definition combined with sufficient obscuration of glare. This last feature can be best determined by the operator owing to individual differences in visual acuity.

2. Lenses should be carefully examined for structural defects, as these are prolific causes of eye strain, and general discomfort, when they come in the line of vision.

3. When cover glasses become spotted and dull, they should be replaced at once by new ones. It is desirable to keep a separate stock of cover glasses for this purpose.

Proposed Tolerances for Ground Thread Taps—Discussion

BY H. C. HUNGERFORD
Pratt & Whitney Co.

Two tables showing the tolerances for ground thread taps as proposed by the National Screw Thread Commission were published on page 25, Vol. 61, of the *American Machinist*. It was noted that "Stock taps are made slightly larger to meet the present demand."

In manufacturing ground thread taps on a commercial basis we have found it necessary to adopt standard tolerances and, in order to meet the demand of a majority of users, leading tap manufacturers have adopted the tolerances shown in Tables 18 and 19, herewith.

TABLE 18

COMMERCIAL TOLERANCES FOR GROUND THREAD TAPS

United States Standard

Size	Basic		Tap Measurements					
			Outside Diameter			Pitch Diameter		
	Outside Diam.	Pitch Diam.	Minimum	Maximum	Tolerance	Minimum	Maximum	Tolerance
¼–20	0.2500	0.2175	0.2520	0.2535	.0015	0.2180	0.2190	.0010
5/16–18	.3125	.2764	.3145	.3160	.0015	.2769	.2779	.0010
3/8–16	.3750	.3344	.3770	.3785	.0015	.3349	.3359	.0010
7/16–14	.4375	.3911	.4400	.4415	.0015	.3916	.3926	.0010
½–13	.5000	.4500	.5025	.5040	.0015	.4505	.4515	.0010
9/16–12	.5625	.5084	.5650	.5665	.0015	.5089	.5099	.0010
5/8–11	.6250	.5660	.6275	.6290	.0015	.5665	.5675	.0010
¾–10	.7500	.6850	.7530	.7550	.0020	.6855	.6865	.0010
⅞– 9	.8750	.8028	.8780	.8800	.0020	.8033	.8043	.0010
1 – 8	1.0000	.9188	1.0030	1.0050	.0020	.9193	.9203	.0010
1⅛– 7	1.1250	1.0322	1.1290	1.1310	.0020	1.0327	1.0342	.0015
1¼– 7	1.2500	1.1572	1.2540	1.2560	.0020	1.1577	1.1592	.0015
1⅜– 6	1.3750	1.2668	1.3790	1.3810	.0020	1.2673	1.2688	.0015
1½– 6	1.5000	1.3917	1.5040	1.5060	.0020	1.3922	1.3937	.0015
1⅝– 5	1.7500	1.6201	1.7550	1.7570	.0020	1.6206	1.6221	.0015
2 –4½	2.0000	1.8557	2.0050	2.0070	.0020	1.8562	1.8577	.0015
2¼–4½	2.2500	2.1057	2.2560	2.2580	.0020	2.1062	2.1082	.0020
2½–4	2.5000	2.3376	2.5060	2.5080	.0020	2.3381	2.3401	.0020
2¾–4	2.7500	2.5876	2.7570	2.7590	.0020	2.5881	2.5901	.0020
3 –3½	3.0000	2.8144	3.0070	3.0090	.0020	2.8149	2.8169	.0020

LEAD TOLERANCE

A maximum lead error of plus or minus .0005″ in one inch of thread is permitted.

MARKING

Taps will be marked with the diameter, number of threads per inch and standard. A symbol indicating ground thread is also recommended, for example:

A tap one inch diameter with eight threads per inch will be marked:

1″ – 8 U. S. S.
G

TABLE 19

COMMERCIAL TOLERANCES FOR GROUND THREAD TAPS

S. A. E. Standard

Size	Basic		Tap Measurements					
			Outside Diameter			Pitch Diameter		
	Outside Diam.	Pitch Diam.	Minimum	Maximum	Tolerance	Minimum	Maximum	Tolerance
¼–28	0.2500	0.2268	0.2520	0.2535	.0015	0.2273	0.2283	.0010
5/16–24	.3125	.2854	.3145	.3160	.0015	.2859	.2869	.0010
3/8–24	.3750	.3479	.3770	.3785	.0015	.3484	.3494	.0010
7/16–20	.4375	.4050	.4395	.4410	.0015	.4055	.4065	.0010
½–20	.5000	.4675	.5020	.5035	.0015	.4680	.4690	.0010
9/16–18	.5625	.5264	.5645	.5660	.0015	.5269	.5279	.0010
5/8–18	.6250	.5889	.6270	.6285	.0015	.5894	.5904	.0010
11/16–16	.6875	.6469	.6895	.6910	.0015	.6474	.6484	.0010
¾–16	.7500	.7094	.7520	.7535	.0015	.7099	.7109	.0010
13/16–14	.8750	.8286	.8775	.8790	.0015	.8291	.8301	.0010
⅞–18	.8750	.8389	.8770	.8785	.0015	.8394	.8404	.0010
1 –14	1.0000	.9536	1.0025	1.0040	.0015	.9541	.9551	.0010
1⅛–12	1.1250	1.0709	1.1275	1.1290	.0015	1.0714	1.0729	.0015
1¼–12	1.2500	1.1959	1.2525	1.2540	.0015	1.1964	1.1979	.0015
1⅜–12	1.3750	1.3209	1.3775	1.3790	.0015	1.3214	1.3229	.0015
1½–12	1.5000	1.4459	1.5025	1.5040	.0015	1.4464	1.4479	.0015

LEAD TOLERANCE

A maximum lead error of plus or minus .0005″ in one inch of thread is permitted.

MARKING

Taps will be marked with the diameter, number of threads per inch and standard. A symbol indicating ground thread is also recommended, for example:

A tap one inch diameter with fourteen threads per inch will be marked:

1″ – 14 S. A. E. Std.
G

These tables are from the Commercial Standards pamphlet as adopted by Tap and Die Manufacturers, and were revised May 1, 1924.

All stock ground thread taps are made to these tolerances, but manufacturers are prepared to furnish taps ground to other tolerances, when so desired. The minimum and maximum pitch diameters should be given when anything different from standard tolerances are required.

Famous Machinists of History

BY H. H. MANCHESTER

William Cockerill (1759-1832)

William Cockerill was born in Lancashire in 1759 and as a youth received a thorough training as a machinist and mechanic. It was said that he could run any machine, and make a model of any one that he saw.

His ability in this respect was so great that he was recommended to Catherine II of Russia, who called him there in order to introduce machinery to modernize Russian industry.

Catherine, however, died two years later, and the mad Tsar Paul threw him into prison for not completing a model on time.

Cockerill escaped to Sweden, where he was commissioned to construct some locks for a canal.

In 1799 he moved to Veriers, in Belgium. Here he constructed the machinery for spinning and weaving mills, including many improvements of his own invention. He established mills of his own there, and became the leading woolen manufacturer on the continent.

In 1812 he retired in favor of his sons.

Automotive Production

Machining Cylinders for the Gray Motor

By Howard Campbell
Western Editor, *American Machinist*

A departmental layout that has attracted attention—Routing of work with descriptions and illustrations of interesting operations—A three-station cylinder fixture—Multiple tapping machines—Finish boring

THE sequence of operations in the machining of an automobile cylinder, and the selection and arrangement of the machines on which the operations are to be performed are matters that have never been settled in the same manner by any two automobile manufacturers. In view of this fact, a departmental layout that has been approved generally by production engineers as having exceptional merit will undoubtedly be of interest. The department under discussion is in the Gray Motor Division of the Kelsey Wheel Co., Detroit, Mich., where the cylinder blocks for the Gray motor are machined.

The machines are arranged as shown in the layout, Fig. 1, and are numbered to correspond with the operations as outlined in the operation layout, the letter O signifying operation number. The department occupies a space 240 ft long and slightly more than 20 ft. wide. The first 40 ft. at the end of the department is used for storage, as indicated. The cylinder blocks are handled between operations by means of a roller conveyor that extends the entire length of the department.

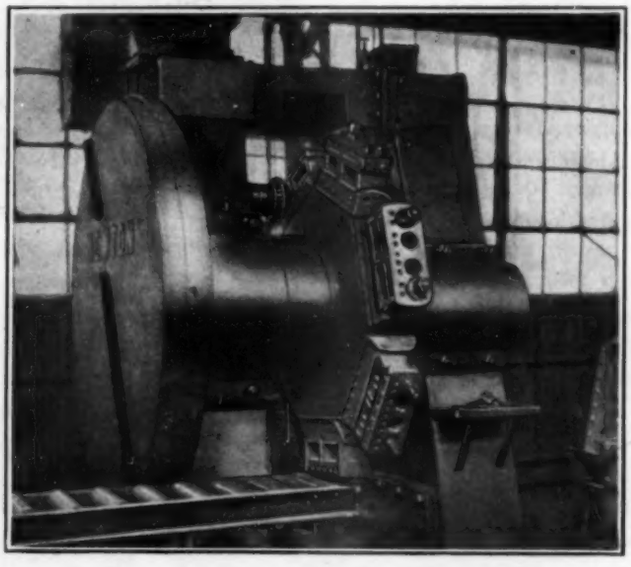


Fig. 2—Milling sides of cylinder block

The first operation, that of rough and finish milling the top and bottom, is performed on a Newton drum-type milling machine similar to the machine shown in Fig. 2. The cylinder passes to a two-spindle drill press, where the operation of drilling and reaming two ½-in. locating holes and drilling two ⅜-in. drain holes is performed, and then goes to the machine shown in Fig. 2, where both sides are milled as shown in the illustration. Two 10-in. and two 6-in. cutters, for the roughing and finishing operations, are in operation simultaneously, the larger cutters running at a speed of 30 r.p.m., while the smaller ones run at a speed of 44 r.p.m. The roughing cutter takes off approximately $\frac{5}{16}$ in. of stock, leaving $\frac{1}{16}$ in. to be removed in the finishing cut. The drum holds seven blocks, which feed past the cutter at the rate of 18½ in. per minute. An output of 42 blocks per hour is possible, although the production is limited by slower operations on other machines.

The next operation is that of rough boring, which is done on a Baker No. 4 four-spindle drilling and boring machine, shown in Fig. 3. The piece is located in a heavy fixture and is locked in position by two cam-action locking devices, one of which can be seen at either end of the piece. Each cutter is made with four inserted blades and is 3⅞ in. in diameter. The cutters revolve at a speed of 80 r.p.m. and each removes $\frac{5}{16}$ in. of stock while feeding 5¼ in. per minute. The bore is 7 in. long and the complete operation is finished in two minutes.

The operation of rough boring the valve throat and spotfacing and drilling the valve-stem holes is performed on the Foote-Burt sixteen-spindle drill shown in Fig. 4, and is handled simultaneously with the preceding operation and by the same operator.

The crank-shaft bearings are finished on the ends by straddle-milling on the Newton special milling machine illustrated in Fig. 5. The machining is done by five 4½x½-in. milling cutters on an arbor located between the

AUTOMOTIVE PRODUCTION

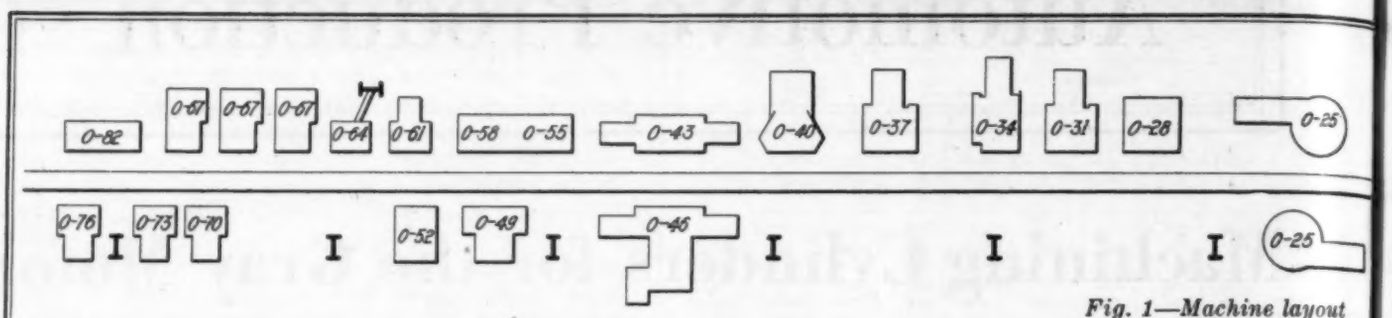


Fig. 1—Machine layout

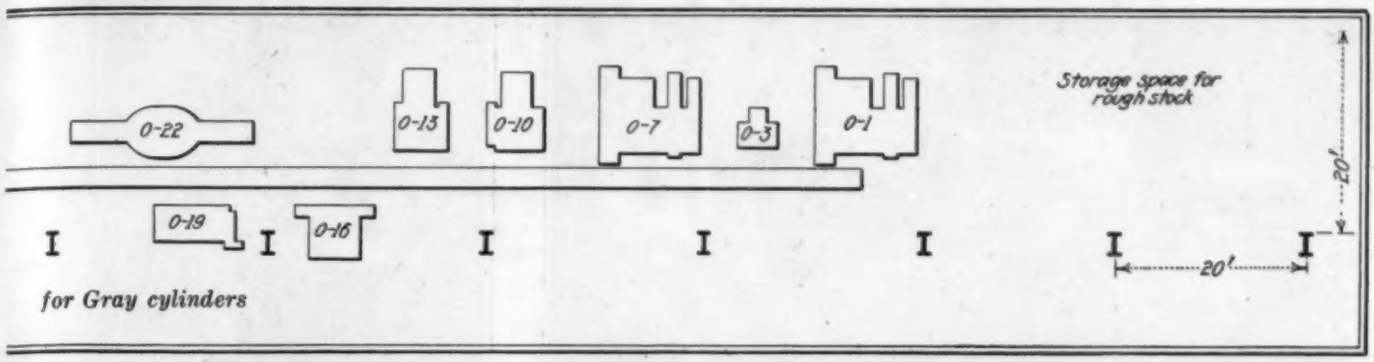
Gray Motor Division of Kelsey Wheel Co., Inc.

OPERATION SHEET

Part No. 7861 **Name** Cylinder Block

Operation No.	Operation	Machine
1	Rough and finish mill top and bottom	Newton drum-type milling machine
4	Drill and ream two ½-in. locating holes and drill two ⅛-in. drain holes	2-sp. Rockford drill press with tapping attachment on one spindle
7	Rough and finish mill both sides	Newton drum-type milling machine
10	Rough bore cylinder bores	Baker 4-sp. boring machine
13	Rough bore valve throats, spot and drill valve-stem holes	Foote-Burt 16-sp. drill
16	Mill front end	36-in. Kempsmith production-type milling machine
19	Straddle-mill crankshaft bearings	Newton special milling machine
22	Core-drill crankshaft and camshaft bearings	Rockford 2-way horizontal boring machine
25	Second-cut and finish-bore crankshaft and camshaft bearings	Two Rockford horizontal boring machines
28	Rough and finish mill radius on rear end	Newton special machine
31	Drill and ream tappet holes	Foote-Burt 16-sp. drill
34	Second bore and chamfer cylinder bores	Baker 4-sp. boring machine
37	Finish ream valve-stem holes, throats and seats	Foote-Burt 16-sp. drill
40	Drill all holes in valve side	Fox multiple drill 12x18
43	Drill all holes in ends	Fox multiple 2-way drill
46	Tap all holes in valve side and ends	Fox multiple 3-way tapper
49	Drill all holes in top	Fox multiple drill 16x32
52	Tap 15 stud holes in top	Fox multiple tapper
55	Plug 5 core holes	Bench
58	Water test	Bench
61	Drill and tap 2 holes in water inlet pad	2-sp. Rockford drill with tapping attachment
64	Drill ⅛-in. oil-pipe hole in center rib	Van Dorn post radial drill
67	Finish ream cylinder bores	Baker drill (3 required)
70	Drill all holes in bottom	Fox multiple drill
73	Countersink 12 stud holes, chamfer and ream three ⅜-in. holes in bottom	Fox multiple drill
76	Tap 16 ⅛-in. 18-thd. and 12 ⅛-in. 14-thd. holes in bottom	Fox multiple tapper
79	Wash	
82	Inspect	

AUTOMOTIVE PRODUCTION



for Gray cylinders

two parts of the table. The table is controlled by a cam action that allows it to feed down until the cut has been completed and then raises it clear of the cutters so that the work can be changed. The cutters operate at a speed of 70 r.p.m. while the table feeds down at a rate of 2¾ in. per minute. A tolerance of 0.020 in. is allowed on all except the rear bearing, which is held to length within 0.003 in. A production of 43 pieces per hour is possible on this operation.

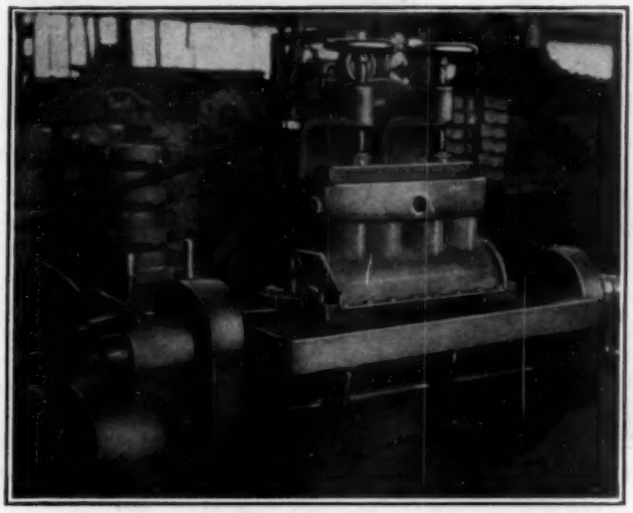


Fig. 5—Milling bearings to length

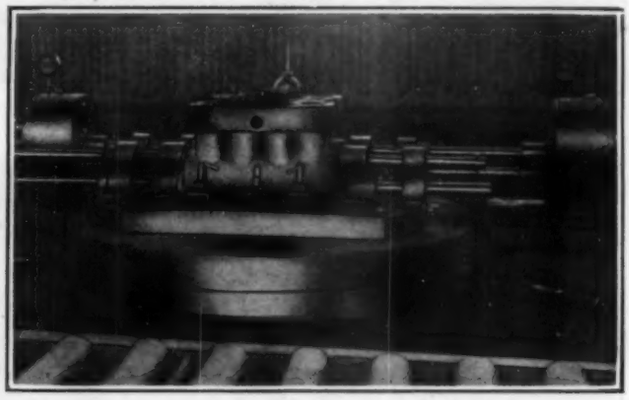
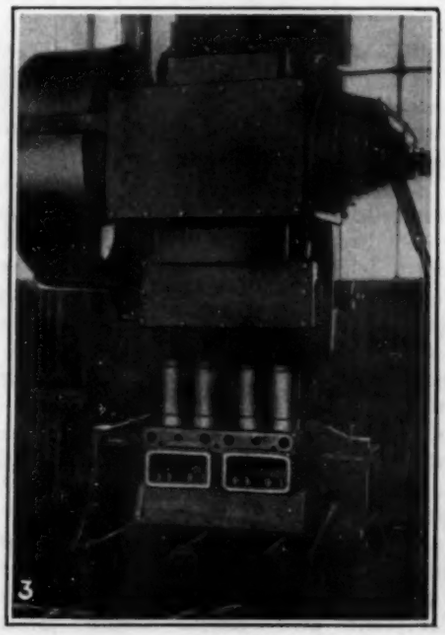


Fig. 6—Rough boring crankshaft and camshaft bearings

The crankshaft and camshaft bearings are core-drilled on a Rockford two-way horizontal boring machine which is illustrated in Fig. 6. Six Morse counterbores of the five-blade variety are used for the job, four of 1.653-in. diameter and two of 1.622-in. diameter. The finish boring operation is performed in two Rockford single-end horizontal boring machines, one of which is shown in Fig. 7. Kelly reamers are used for the operation, three reamers being located on one arbor. Aligning bars are used to check the gear-center dimensions, which are held within 0.002 in. Two fixtures are used on the tables of each of the machines shown in Figs. 6 and 7, this arrangement making it possible to change pieces in one fixture while the other piece is in process. Two sets of bars are also supplied so that the only time lost between pieces is that necessary to revolve the table and attach the boring bars to the machine spindles. All holes in the valve side of the cylinder



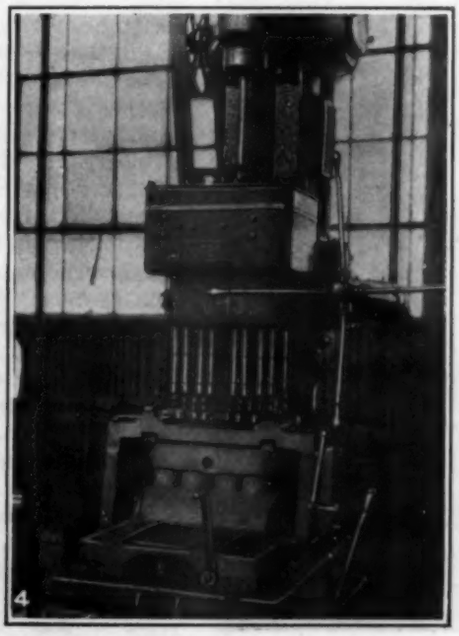


Fig. 3—Roughing boring cylinders. Fig. 4—Rough boring valve throat and drilling valve stem holes

AUTOMOTIVE PRODUCTION

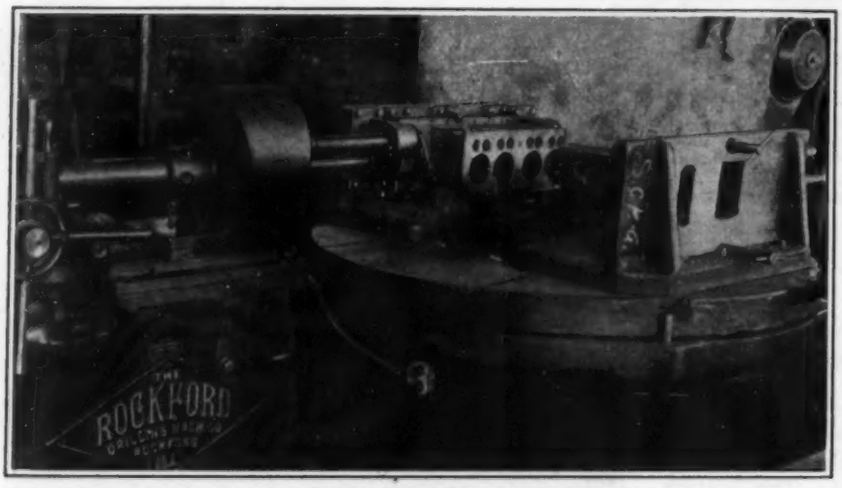


Fig. 7—Finish boring the bearings

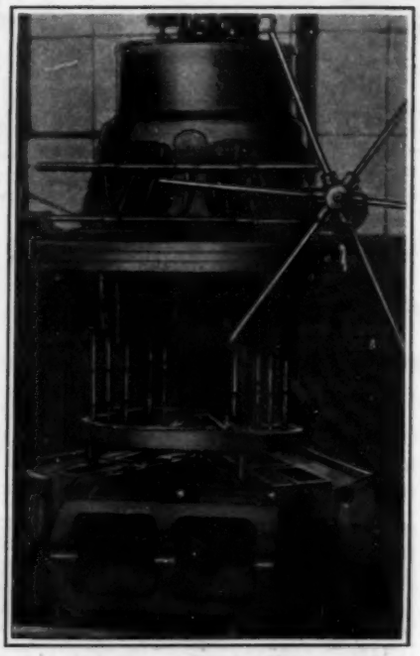


Fig. 8—A 3-station jig expedites the work

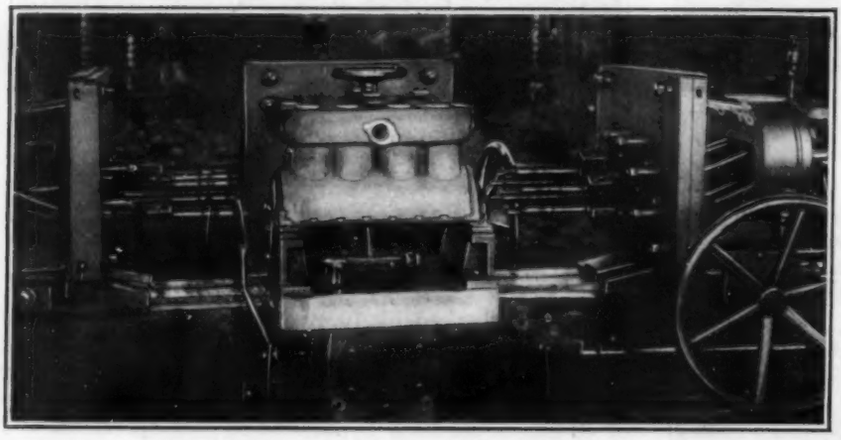


Fig. 9—Tapping ends and side in 3-way tapper

are drilled and counterbored with a Fox multiple drill, using a 3-station jig as shown in Fig. 8. The pieces are changed at the front of the machine while the machine is in operation, each piece passing to the second station for drilling and to the third for counterboring. The machine is in continuous operation, excepting for the time necessary to index the jig, making possible a production of 48 pieces per hour.

The holes in the valve side and both ends are tapped in the Fox multiple 3-way tapper illustrated in Fig. 9, sixteen $\frac{3}{8}$-in. 16-thd. taps being in operation at once, each running at a speed of 300 r.p.m. Fifty pieces per hour can be obtained on this operation, although the production is limited by the other operations.

Only one bore of a cylinder is finish-reamed at a time, this operation being performed on a Baker drilling and boring machine as shown in Fig. 10. The reamer is $3\frac{3}{8}$ in. in diameter with 8 inserted blades and is tapered on the end so that the cylinder will locate itself centrally. The spindle runs at a speed of 48 r.p.m. while feeding 0.125 in. per rev., or at a rate of 6 in. per minute. From 0.009 to 0.012 in. of stock is removed in the finish operation. All the bores in each cylinder block are bored with the same reamer so that all the pistons in any motor will be of the same size and weight, which makes for balance in the motor. One operator runs a battery of three machines and produces 20 cylinders per hour.

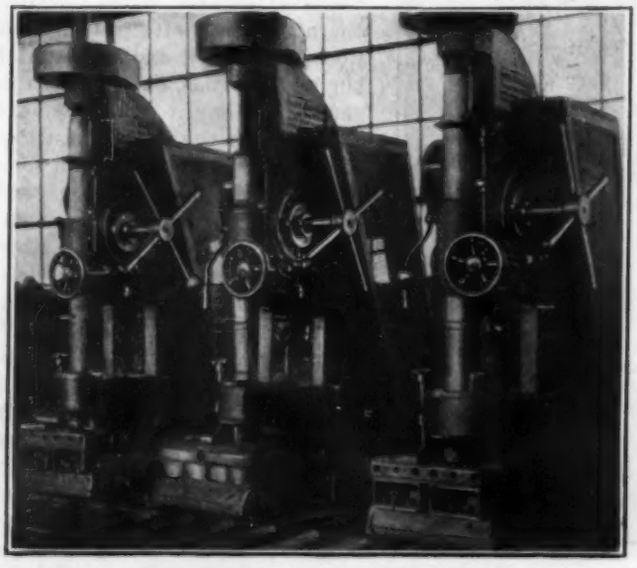


Fig. 10—All cylinder bores are finished with the same reamer

A growing demand is reported for Saxon tools and small machines, according to advices to the Department of Commerce from Berlin. Although the world market prices for tools are very low at present, German firms have been able to cut their prices and are meeting the competition of Swedish firms. Business is mostly reported from firms with own agencies abroad. Most tools are being shipped to Spain and Italy and small machines also to England and to Latin America.

Ideas from Practical Men

Devoted to the exchange of information on useful methods. Its scope includes all divisions of the machine building industry, from drafting room to shipping platform. The articles are made up from letters submitted from all over the world. Descriptions of methods or devices that have proved their value are carefully considered, and those published are paid for

How to Make An Odd-Sized Drill

BY DONALD A. HAMPSON

Every machinist at some time or other has wanted a drill or a reamer of some odd size. Perhaps it was a hurry job of repairs or, again, an experimental job where the drawing showed this troublesome size ahead of the actual need. In the latter case, catalogs are consulted and the list of wire, letter, and metric sizes of drills are scanned for something that can be ordered to come in about the time the holes are ready for machining. So far as reamers are concerned, one knows in advance that there is no choice but to grind one down to the odd dimension.

Recently, a shop in eastern New York received an order from a customer in Arkansas for 50 knuckle arms as per sample. The arms were to be a press fit on a 0.225-in. shaft and the length through the hole was ¼-in., the material being soft steel. The arms were replacements—the wearing members of a device that had been made by a firm that had gone out of business—and the reason for the odd size shafts was not apparent. However, the latter were in perfect shape and the customer could see no difficulty in fitting the new arms.

No drills of 0.225-in. diameter are listed, nor could a size smaller be safely used when ground to cut larger than itself, because of the uncertainty of this kind of drilling. A ¼-in. reamer when ground down this much would have no cutting angle, and, besides, most of them are made with male centers, for which the shop had no grinding equipment.

The method used to secure the right-sized tool was most satisfactory and can be applied to many similar cases. It is a hurry-up process and is not expensive. The 0.225-in. drill was produced in less than half an hour.

There happened to be one drill in the shop of the 0.228-in. size. A piece of ⅜-in. brass rod was chucked and this drill run through it, following a 7/32-in. lead hole. Then the brass was taken out and split longitudinally for about half its length. This made the lap that was to reduce the drill to the desired size.

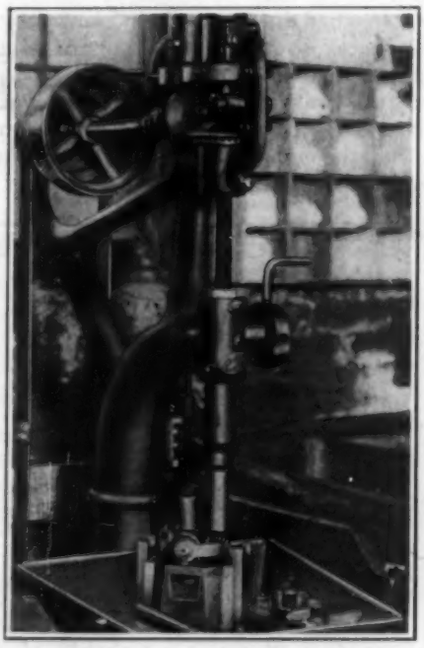
With a dog on the drill the lap was run in the chuck, quickly reducing the lands. As the lands wore down, the chuck was tightened and thus squeezed the brass enough to close up a few thousandths. Oil and cast-iron dust were used for the work, the iron dust merely because it happened to lie in the lathe pan below, but it worked in this case as well as a conventional abrasive. In doing the work, care was taken to reduce the entire length; not to run down near the point and so make a drill that would pinch.

When the 0.225-in. size was reached, trial holes were drilled in pieces of the same depth and material as the knuckle arms. When the holes showed a little too large, a brief additional lapping was sufficient to bring the drill to exact size. It had been the intention to use a lead hole, but trial showed that the holes were of correct size with no appreciable difference at the ends and so the lot was drilled right through. Though the finish was equal to the best reamed work, the drill did not bind in the holes; for there was plenty of height left on the lands to clear the major part of the drill's periphery.

Using the Drill Press for Setting Nuts

BY WILLIAM F. SANDMANN

A certain manufacturer of universal joints "runs in" every joint after it is assembled, disassembles it for inspection, and then reassembles it for shipment. As the sections of the joint are held together by four studs, twelve separate operations of putting on or removing nuts are necessary before the joint is ready for shipment.



Setting nuts with a drill press

To facilitate the work of setting and removing nuts, a drill press that is fitted with a friction-driven tapping device has been rigged up as shown in the illustration. A driver is made with a taper shank to fit the spindle of the machine and a special fixture provided to hold the work. The fixture is rotatable to bring each nut successively under the spindle.

An oblong recess is made in the lower end of the driver by counterboring two holes, one on each side of the center and cutting away the stock between them with an end mill. The diameter of the counterbored holes, and consequently the width of the recess, is equal to the distance across the flats of the nuts, so that it grips on two sides of the nut only.

The friction of the tapping device is adjusted to slip at the moment the nuts are set up sufficiently tight. To remove the nuts, the tapping device is adjusted to drive the spindle in the opposite direction.

A Foundry Kink

By Sandy Copeland

A heavy gear-casting of semi-steel that was being made in quantities was giving trouble because of porous spots in the metal at the places where the spokes joined the rim, and in some cases one or more of the spokes would pull away from the rim entirely in cooling. As will be seen from the illustration, the design was somewhat unusual, there being a double set of wide spokes, and each set was placed close to the end of the hub. These gears — of which there were two sizes, approximately 4 and 6 ft. in diameter and 2½ in. circular pitch — were first cast with solid drums. They were to run at comparatively high speeds and were required to transmit powers up to nearly the limit of their strength.

Relieving shrinkage strains in gear casting

The trouble was remedied in the manner shown, by molding four tooth-spaces over each junction of rim and spoke. The spacing had to be quite as accurate as though the entire face was so molded, and it was necessary to exercise care in placing the castings on the gear cutter so that the embryo teeth would coincide with the spacing of the machine.

Fixture for Machining Gear-Case Trunnions

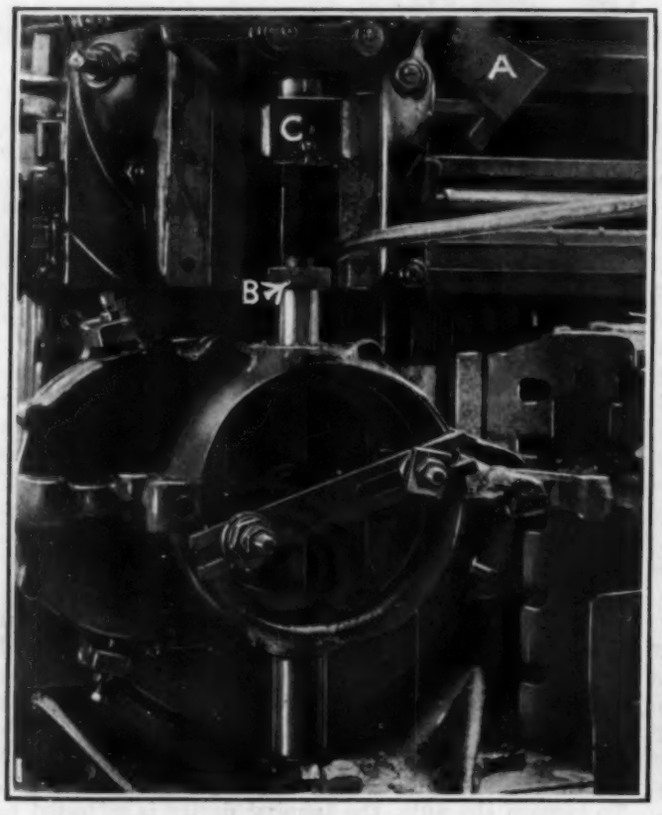
By Henry C. Francis

An indexing fixture for machining the gear-case trunnions of the electric truck, built by the Commercial Truck Co., Philadelphia, is shown herewith. The machining is done on a Bullard vertical lathe in the usual manner, the fixture being so designed that it can be indexed 180 deg. so as to bring the trunnions in line with each other. Fig. 1 shows the gear case in the first position, the trunnion having been turned and threaded.

While there is nothing specially unusual in the machining of the trunnions, it may be of interest to note the double tool holder at *A* used for turning. The special feature of the operation, however, is the use of a solid, square die for threading the ends, the die being shown at *B*. The die is held in a simple holder *C*, the thumbscrew being for the sole purpose of preventing the die from dropping out of the holder. The die usually remains in the holder but is shown threaded on the piece, in order to illustrate the operation.

The use of a solid die for this purpose will probably be questioned by many but its use is the result of experimenting with a number of self-opening dies, this experience seeming to indicate that in this particular case, the use of a solid die was more economical. The wear of the die is watched very closely and the die is replaced with a new one as soon as the maximum limit of wear has been reached.

The machining operations on both trunnions are the same. Fig. 2 shows the fixture indexed 180 deg. and the first, or facing tool, about to begin work on the end of the second trunnion. The method of holding the case in the fixture is clearly shown in both illustrations.



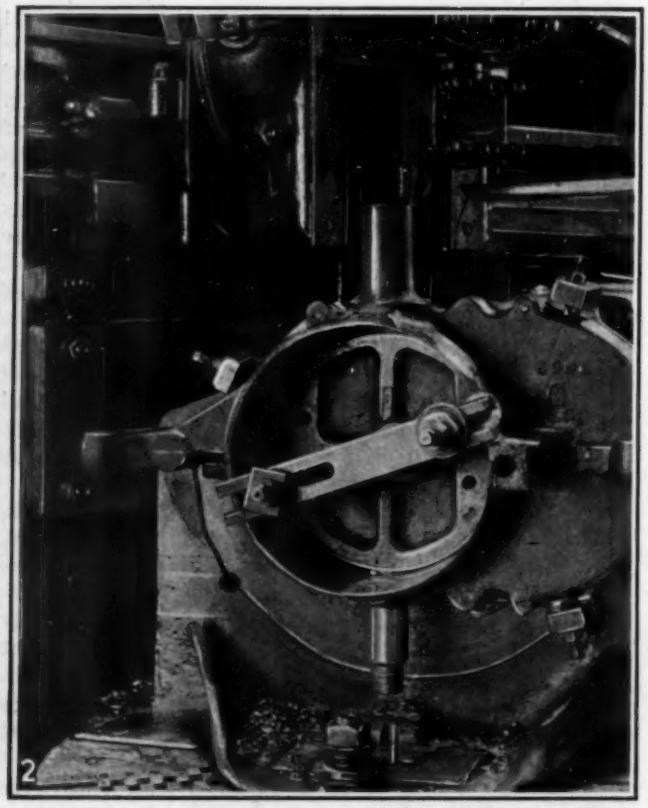


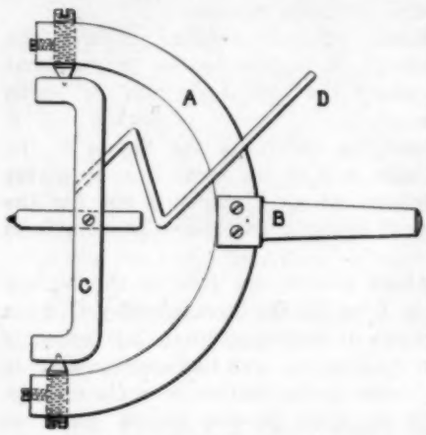
Fig. 1—Turning and threading a trunnion. Fig. 2—Beginning work on the second trunnion

Radius-Truing Device for Grinding Wheels

By Ralph W. Dicely

The device shown in the accompanying illustration is designed for the purpose of dressing convex and concave radii upon the wheels of Brown & Sharpe grinding machines.

Part *A* is made from 1-in. square steel, bent to a radius of 3⅜ in., and is attached by two screws to the shank *B*, which is fitted to the tail-spindle of the machine. Part *C*, in which the diamond holder is held, swings upon 60-deg., cone-pointed, hardened screws locked in place by small set-screws after adjustments have been made.



Device for turning radii on grinding wheels

Part *C* is made of ⅛x1-in. steel, so machined that the front edge is ⅛ in. back of the center of swing, making it possible with the device to turn a convex radius upon the grinding wheel. The lever *D* is bent toward the center of the device so that part *C* may be swung nearly half-way around.

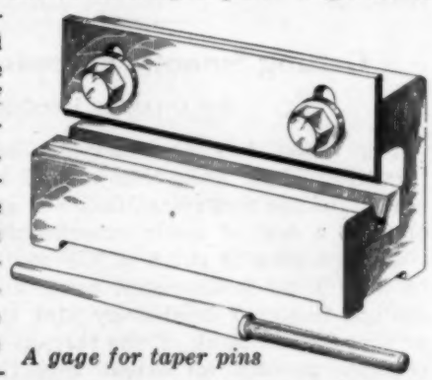
It will readily be seen that by setting the diamond ½-in. from the edge of the part *C* a ⅛-in. convex radius may be made upon the grinding wheel, or by setting it out to ⅛ in., a ½-in. concave radius may be obtained.

A Gage for Testing Taper Pins

By F. W. Ming

One of the methods employed to test the accuracy of taper pins is to set them in a V-block under a tapered knife-edge that is adjusted to the correct angle. Such a gage for testing No. 1 Morse-taper pins is shown in the accompanying illustration.

The body of the gage is a casting with an L-shaped overhanging arm cast as an integral part. A groove of rectangular section is milled lengthwise in the upper surface of the body to contain the V-block, and the perpendicular face of the overhanging arm is machined parallel with, and directly over, the center of the groove. The supporting part of the arm can be cast with an opening of generous proportions to admit light back of the knife-edge. All corners of the casting should be rounded nicely.



A gage for taper pins

The V-block is made of machine steel, casehardened and ground accurately to dimensions. The width of the block should be such as to fill the slot in the base casting, to which it is held by four fillister-head screws. The V-groove should be of 60-deg. included angle, with clearance slot about ⅛ in. wide at the bottom.

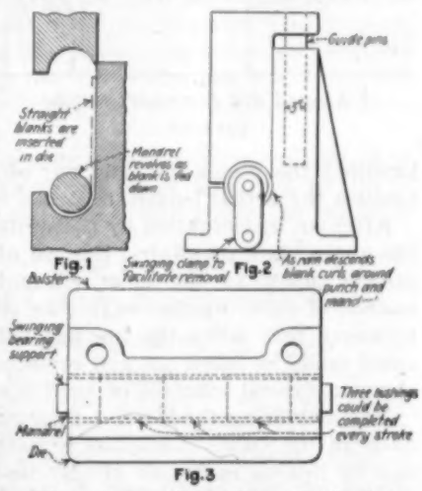
The knife-edge is made of tool steel, carefully hardened and accurately ground. It is held to the face of the overhanging arm by two fillister-head screws passing through elongated holes, or slots, in the blade to provide for vertical adjustment of the latter. The gaging edge should be beveled to about 45 deg., leaving a flat of not more than ⅛ in. in width that is square with the face. The holding screws should be provided with round-edge washers.

A master-plug, also shown in the illustration, should be made with which to set and check the gage. This can be made of machine steel, casehardened and finished all over. The knurled handle provides a convenient means of manipulating it while setting the gage.

Press Tools for Making Bushings

By C. Overton

The sketches herewith illustrate a set of press tools for forming split bushings in one operation after blanking, and are adapted to all work of that nature in which the relation between the diameter of the bushing and the thickness of the stock is such as to not overstrain the mandrel. Almost all usual proportions of bushings fall within limits of wall thickness and diameter that admit of such methods, but disproportionately heavy stock cannot, of course, be bent around too small a mandrel successfully.



Figs. 1, 2 and 3—Press tools for making sheet-metal bushings

The punch and die are shown open, in vertical section in Fig. 1. The guide pins, as shown in Fig. 2, maintain close relation between the sides of the punch and face of the die, while the mandrel is loosely held in the arms of the swinging clamp to facilitate the removal of work.

When the blank is fed into the open dies, as shown by dotted outline in Fig. 1, the descending ram forces it behind and around the mandrel, within the die concavity, until it is entirely wrapped around the mandrel, in which position it is given its final set by the concavity of the punch.

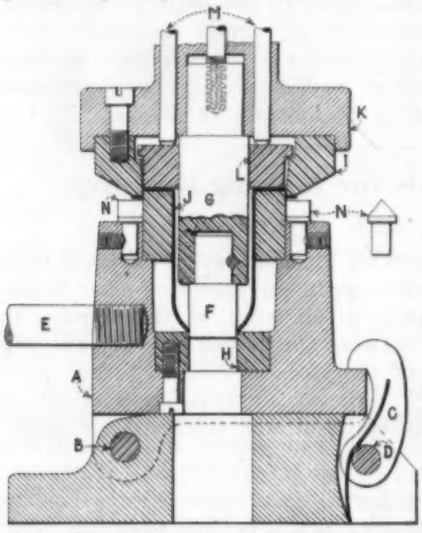
In Fig. 3 the tools are shown in an assembled plan-view with the mandrel arms removed. There is sufficient spring in the stock so that the finished work readily slips off the mandrel. The stock should be well lubricated and if very stiff stock is used, it is better to make the straight backing for the blank a part of the punch, rather than of the die, but equally good results may be secured by either construction on light stock.

Hinged Dies for Piercing and Trimming Long Shells

BY F. O. HICKLING
Newark-on-Trent, England

Presswork, like all other classes of production, depends for its progressive and steady flow through the various operations upon the machines at one's disposal, particularly so when varying lengths of stroke are required on the jobs, for it generally happens that all of one kind of work will get bunched up, waiting for a press of sufficiently long stroke to accommodate it.

When all the short-stroke presses are busy, it is comparatively easy to use those of longer stroke to maintain the steady flow of work in hand, even though the latter could be done upon a short-stroke press; but the real trouble arises when the particular job demands a long stroke and all the long-stroke presses are in use. A summary will often reveal the fact that quite half of the work on the longer-stroke presses is being done on those machines in order to facilitate handling the pieces into and out of the tools, and not because the actual length of stroke is necessary.



A hinged die for short-stroke presses

After an investigation by the writer that brought out the above state of affairs, the use of a hinged die was decided upon as the most efficient and satisfactory method of relieving the congestion, the hinging being so arranged that when the die was tilted over, the work could easily be taken out and replaced. The illustration shows a typical example of such a set of tools.

The swivelling die-block *A* fulcrums about the pin *B*, fixed in the base. Location is maintained by the pin and by lips on each side of the die-block that register it with the machined sides of the base. The latch *C* swivels on pin *D*, to which it is fastened so that the pin rocks in the hole in the base as the latch is moved. An extended portion of the pin *D* protrudes to the side of the base, and on this a hand lever, extending to the front, is fixed, in order to facilitate the release of the latch.

A handle, *E*, is attached to the swivelling die-block *A*, being conveniently placed for the operator to work it with his left hand. It is of suitable length to give a good three-to-one leverage, so that the effort required to move the unbalanced mass of the die-block is comparatively slight, and therefore renders the operation of loading and unloading quite easy.

On completion of the operation, the procedure for extracting the component from the die is as follows: First, with his right hand, the operator swings the latch *C* out of engagement by means of the lever previously referred to. Then, while still holding the latch out, he swings the whole die-assembly over to an angle of approximately 45 deg., using the handle *E*. His right hand, now being released from the duty of holding the latch lever, and still holding the handle *E* with his left hand to prevent the die-block from returning to its upright position, he extracts the component from the die and inserts another piece.

While this may sound a somewhat cumbersome procedure in cold print, it is quite simple in practice, and when the operator becomes accustomed to the movements the time taken to go through the evolutions is no longer than with ordinary methods.

While the primary interest centers around the swivelling arrangement, it occurs to the writer that one or two points about the tool itself may be worth mention in passing.

The tools are used for trimming the flange of the shell shown in the die, and at the same time to pierce the hole at the bottom, which is punched out for the following operation of drawing the barrel to a uniform diameter.

The punch *F*, which pierces the hole in the bottom end of the piece, is fixed to the punch-holder *G* by a cross-pin, this method of construction being not only more convenient in making the tool but also cheaper in every way—particularly in the matter of replacements. The bottom die *H* is fixed in the swivel block as indicated.

At the same time that the hole is pierced, the top die, or cutting-ring *I*, trims the flange, the punch *J* being the bottom tool. The cutting-ring is fixed in the holder *K*, which also holds the punch-holder, on the shank of which the stripper *L* is a sliding fit. The pins *M* transmit the necessary pressure from a spring in the shank portion of the holder.

The scrap from the hole falls away through the clearances in the die-block and base, but the ring that is trimmed off of the flange adheres to the punch until the next piece is trimmed, when the tool pushes down the first one and forces it onto the two side cutters *N*, and these divide the ring into two parts which then fall away. These two scrap-cutters are held in the die-block *A* by means of setscrews. The form of their cutting edges is shown in the side view.

Although but one tool is shown adapted to this method of hinging, it will be obvious that almost any form of tool for a similar purpose can be treated in like manner, since when the tools are actually in action, the whole assembly is to all intents and purposes a solid block.

Getting Smooth Threads on Fiber

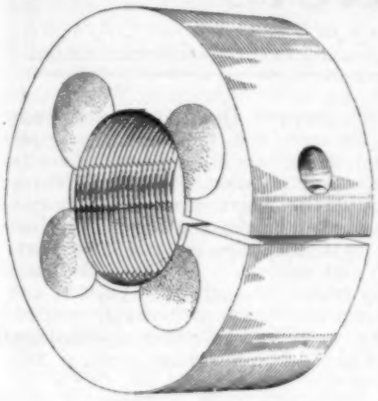
BY CHARLES KUGLER

The writer had an experience some time ago in threading black fiber that should be of interest to readers of the *American Machinist* and may save some of them a deal of costly experimenting.

I was trying to cut 8 p. V-threads on round pieces of fiber 1 in. in diameter, using an ordinary button die and though I tried every kink that was suggested or that I could think of, the threads on the fiber would crumble to such an extent that the work was not acceptable. The kink that finally enabled me to do the job satisfactorily is shown in the accompanying illustration.

I took some pieces of the same material I was trying

to thread and plugged the clearance holes in the die. I then set the die in a chuck in the engine lathe and with a threading tool made of *brass*, I cut threads in the fiber plugs to correspond with those of the die so that the latter, except for the color, presented the appearance of a plain threaded hole without clearances. The reason for using a brass tool instead of a steel one is obvious; a steel tool would probably ruin the die.



A die for threading fiber

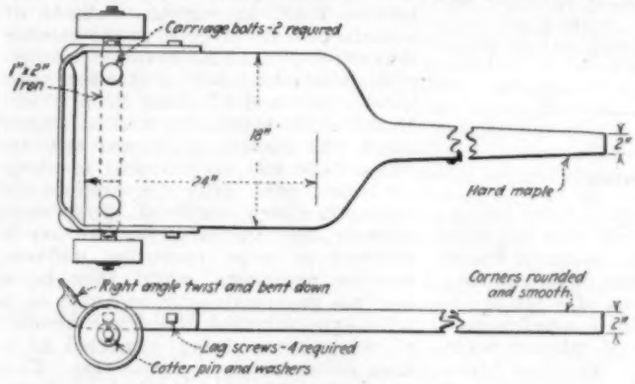
I then filed away the first turn of thread from the fiber plugs, exposing the first ring of cutting teeth of the die. This tool I found to work very satisfactorily, as the fiber plugs appeared to support the threads as fast as they were cut upon the work and there was no further trouble from crumbling.

A Handy Two-Wheeled Truck

By H. L. Wheeler

The sketch shows a handy little two-wheeled truck for moving heavy articles about the shop, as moving a fixture from the toolcrib to the machine upon which it is to be used, and vice-versa. It is simple, can be made very cheaply, and it will soon repay the cost of the time and material expended in making it.

The body should be made in one piece with the handle, preferably of hard maple. The axle is a piece of



A handy shop truck

1x2-in. iron of suitable length, turned at both ends to form the bearings for the wheels and attached to the body with a couple of carriage bolts. Any small cast-iron wheels will do, and may be held on the axle with washers and cotter pins.

The only remaining iron work is the lip, and that is made of 1x2-in. iron, twisted and bent as shown, and attached to the sides of the body with four lag-screws.

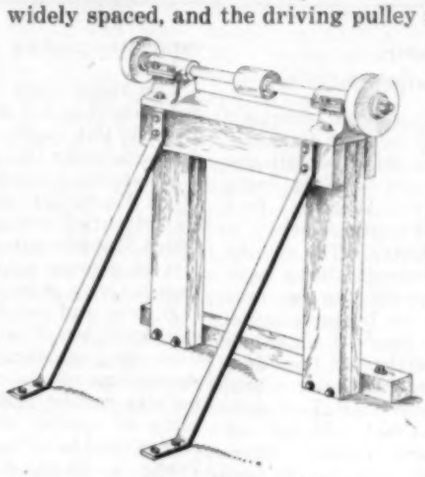
This truck takes up much less room than the two-wheeled trucks ordinarily found in machine shops and may easily be shoved into a corner out of the way when not wanted. Plenty of use can be found for it in most shops.

Home-Made Appliances

By Henry C. Francis

The grinding stand shown herewith was built up from timbers reinforced by flat iron braces from the top to the floor. The timbers are about 2½x6 in. and the braces about ¼x2 inches.

The head is of cast iron, the two bearings being very widely spaced, and the driving pulley in the center. The timbers are bolted together and to the concrete floor, making a very rigid combination.



A rigid grinding stand

In the same shop is a very clever line-shaft clutch device, built up from a multiple-disk clutch and a Hyatt roller bearing such as are used in the Ford car. The clutch fingers are operated by a lever coming down to a convenient position. The two devices described are in the shop of George Miller, Bradentown, Florida.

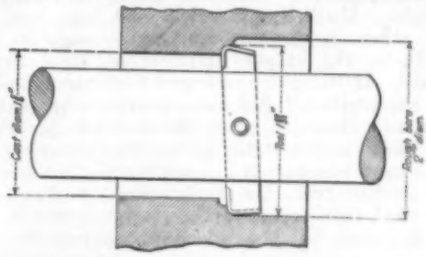
In a previous shop that was so damp that leather belting would not stand at all, Mr. Miller made what he called a "nobby tread" belt from the worn treads of old automobile tires, cutting away the sides. The pieces were held with wire belt hooks and the belt drove well under bad weather conditions, with the rubber side to the pulley,

In some cases, on belts running in wet places, it is said to be necessary to use what is known as North Carolina belt dressing, which is nothing but pine tar or pitch.

Double-End Cutter for Boring Bar —Discussion

By S. Anderson
Arbroath, England

In an article under the title given above by Charles D. Folsom Jr., and published on page 447, Vol. 60 of the *American Machinist*, it was stated that the length



The double-end cutter in question

of the boring tool should be 1$\frac{11}{16}$ in. if the 1$\frac{5}{8}$-in. hole is to be enlarged to 2 inches.

Should not the length of the tool be 1$\frac{13}{16}$ in., as per accompanying sketch, instead of 1$\frac{11}{16}$ in. as stated by Mr. Folsom?

[We believe our contributor is correct in his conclusion.—Editor.]

Technical Abstracts

Forecasting Demand for Industrial Equipment

Ernest F. DuBrul, general manager of the National Machine Tool Builders' Association, Cincinnati, contributes this interesting article dealing with what he calls, "The Machine Tool Barometer and the Business Cycle," in the machine tool industry. The wrecks and losses of the post-war slump have done some good by awakening business men to the facts of the business cycle.

In March, 1917, Prof. J. Maurice Clark published an article in the *Journal of Political Economy* going still further into the analysis of these conditions. Professor Clark pointed out that equipment demand is dual in character, that machines are bought for replacements, and for expansion of facilities to take care of increasing demands for the product of the machines. He showed that these two classes of demand acted differently. Replacement demand varies roughly with the amount of product made, and expansion demand varies with the rate of growth in demand for the product of the machine.

A moment's thought will show that this fact makes management of machine-building shops decidedly more difficult than that of factories using the machines to make consumer goods. Take a machine shop built to supply one user's expansion demand for a time. Before the demand for the final product actually falls off, it begins to slacken in rate of expansion. So the machine user does not order machines as fast as he did before. If this demand stops growing, even though it does not decline, he needs no more machines to take care of the growth. The machine builder is entirely cut off from that user's expansion demand and finds himself with a plant much too large for the economical supply of mere replacements. Until, and unless, he can find other customers or make other products, the excess plant is a social waste. If the price charged for the machines produced did not recoup the cost of the plant, to cover depreciation and obsolescence until again employed, the user has gotten his machinery below its true cost. He is convinced that this vital fact accounts for many business failures in the mechanical industries.

In actual practice members of the Association were asked to report their own current monthly orders and cancellations in order to arrive at some sort of an index which was done by averaging figures received. For two years these were checked with the quantity statistics of orders received from the 29 members reporting numbers of machines, and then this barometer curve was tied up with other business indexes.

The three most significant series of data found so far are: first, commercial 60 to 90 day paper rates; second, Standard Statistics Co.'s index of 202 industrial stocks quoted on the New York Stock Exchange; and third, orders for clay firebrick reported by the Refractories Manufacturers' Association. This last is a more sensitive index of business activity than machine tool orders.

Buyers and builders of machine tools can make practical use of information like this, particularly in scheduling operations of their plants as well as policies can be laid out. A fair sprinkling of special work as well as machines that have been made up to stock, keeps a more flexible organization. When business is improving, stocking of parts can commence with those requiring the most labor and least material until material prices show signs of bottoming; then heavy stock parts should be driven ahead. In this way the best use of cash resources will be had and obsolescence of stock will be minimized. In dull times most users lack either will to buy or power to buy, or both. But in such times all of them have time to listen if the salesman has something new to tell them. Even in dull times some users have power to buy and can be induced to exert the will to buy if shown a new cost-reducing machine tool.—*Mechanical Engineering*, Sept., p. 539.

Handling Large Railroad Stores

E. Harty contributes a brief but interesting article dealing with the store department which the Southern Pacific Co. has placed in service at Sacramento.

This is the first unit of what are to be the largest facilities devoted to storage and distribution of railroad materials in the country. The two structures already erected consist of a main store building of two floors, 500 ft. long with platforms making it 700 ft. in all. A firebrick oil house is equipped with complete handling equipment. Materials are divided into sections of departments similar to the arrangement common in the best industrial stores practice. These sections are in charge of section stock men, each one attending to ordering, receiving, storing, and each has his own particular materials. A large scrap assembling, classifying and salvaging department is also operated from here. At the shops equipped with motor trucks, cranes and industrial cars, all materials ranging from huge locomotive cylinders down to ice for drinking water are delivered to the mechanics on the job. This work extends beyond the immediate shops and through the medium of supply trains. Materials are delivered directly to the user all along the line. Three trains leave Sacramento each month carrying materials of every kind. One goes east to Ogden, one north to Portland, and one south to Santa Barbara. These trains also afford inspection and personal knowledge of material requirements by division officials.—*Management and Administration*, Sept., p. 287.

Coining and Subpress Methods

This paper by D. H. Chason, equipment engineer, Singer Manufacturing Co., is called "Comparative Methods of Tool Design," but we have changed the title to the above, believing this is a more modern name and also because of the interest that is at present shown in coining press-work, which Mr. Chason calls "cold swaging." The paper deals somewhat with the production of sheet-metal parts but many illustrations are given of drop forgings that formerly were machined all over and are now finished in the coining press. There are more ways of designing tools and machinery for sheet-metal work than any other branch of the metal industry, and often some part that is to be made of sheet metal presents a unique problem in itself as various methods of manufacture are involved in the number that are required. An example is taken of a plain washer ½-in. in diameter with a ¼-in. hole and of stock 1/32-in. thick. If only 5,000 blanks are wanted simple punch and die are considered and the whole 5,000 can be produced in about an hour's work after the preliminary tooling has been completed. Supposing, however, that the same ½-in. washer is required in large quantities, millions, suitable equipment would then be a multiple progressive die, mounted on a pillar-type subpress, the upper member of the subpress being connected by a loose connection to the press ram. This type of outfit would produce from 25,000 to 100,000 pieces per hour, depending on the press size.

The design of pillar-type subpress is taken up and there is also an article on the care of the subpress. Too often subpresses are left lying around the shop or under the press itself. These should be treated just as any other tool; cleaned, oiled and placed on the rack ready for the next time they are required.

For coining work the toggle type of press is recommended. The slow action of hydraulic presses exerts a continuous punishing action on the dies that break them down much faster than the speedier stroke of the knuckle-joint embossing press.—*Mechanical Engineering*, Sept., p. 531.

German Stellite Alloys

The Siemens Works and the Deutch-Luxemburgische Bergwerksund Huetten A. G. have carried out experimental developments of alloys similar to stellite. These alloys have been given the name Akrit. They cannot be forged, but must be cast and ground to shape. In order to form high speed tools, they are resistance-welded or copper-soldered to steel shanks. Just as does ordinary stellite, they give very high heat resistance and durability. They are also non-corrodible. The chemical composition of Akrit semes to vary and is given only in a very vague way. The qualities depend also on the mode of melting.—*Die Kraftmaschine*, July 25, p. 146.

Psychological Tests

Josephine R. Glascock, psychologist of R. H. Macy & Co., New York, in discussing this subject states that the standardization of a psychological test is not simple. There must be first of all an analysis of the trait to be tested, or of the ability called for by the job. Applicable tests must be selected or devised. Experiments on many cases must be conducted. The results must be submitted to unemotional, unbiased statistical procedure and, if those results are favorable, we will have a test which we may try with some confidence that it will tell the story that we want. However, particularly with tests in business, it is not until that test has been followed up for a period of time that it may be considered reliable, and as a matter of fact, the follow-up must continue indefinitely because a change in either the grade of applicants or the conditions of the job itself, will probably alter the significance of the test correspondingly.

Psychology does not yet offer an adequate solution of our problems, but given our university laboratories and the intelligent support of business men, psychology should approach its goal even more rapidly than did the study of medicine whose origin was likewise clouded by superstition and mystery.—*American Management Review*, Sept., p. 7.

Tool Storage and Control

F. A. Pope, mechanical engineer, the Worthington Pump & Machinery Co., in describing the Worthington tool system states that the general condition of all special tools is carefully watched and where repairs are needed these are made as promptly as possible. This procedure includes not only jigs and fixtures, but all micrometers, verniers, dial indicators, and similar items which, though not special, are nevertheless, numbered so as to permit of identification and closer attention to a periodical inspection of their condition and accuracy. This applies particularly to both inside and outside micrometers, which are returned to the tool storeroom every Saturday forenoon, checked, a record of this checking made, and then re-borrowed if needed. In addition to this regular weekly inspection, micrometers are checked every time they are issued on loan, and again when received on their return. This applies whether they go out only once in a month or several times in one day to different men; they are inspected "out" and "in."

In cases where tools are sent out of the tool storeroom for repairs or adjustments a small, red tag is hung on the rack hook or placed in the compartment where the tool belongs. This tag serves as a "flag" signal to indicate quickly why the tool is out and functions as an efficient reminder at all times.

They formerly used the simple single brass tool-check system. Simple, it is true, and as inadequate as it is simple for a large shop where jobs are unavoidably constantly changing and, as a result, tools are moving in and out of storage in great variety on loans to many different workmen. The main (and entirely sufficient) objection to the single check is that its misplacement is easy, especially when loan transactions are numerous. This leads not only to endless argument and loss of time, but in such cases the check ceases to be of any value whatsoever as a receipt.

The present system of checking is based on the double-entry idea. The essential and important record of every loan transaction is covered by a written and signed receipt, in duplicate, for every case. Any number of tools, within reason, can be borrowed on one tool receipt at one time.—*Factory*, Sept., p. 346.

Machine Forging Dies

There are many pieces forged on a quantity production basis which are not given a final machine finish. This class of work is also rough when it leaves the forging department, but the quality of the finish must be higher. A number of the parts used in agricultural and similar equipment belong to this class of work. Many of the pieces are simply drawn out, flattened, or bent to the desired shape, the work in some cases being accomplished under a drop hammer, and in other instances by means of either power presses or bulldozers.

C. C. Hermann, chief engineer, the Litchfield Manufacturing Co., Waterloo, Iowa, takes the specific example of a steel hinge made of $\frac{7}{8}$-in. open-hearth round steel and gives an illustration of the drop-hammer dies for producing this piece. He also shows a low carbon steel plate with a collar forged around the hole, a type of forging which is often found in jig work where a hole is punched through one end of the plate. The dies and method of processes of this are given in some detail.—*Machinery*, Sept., p. 34.

Individual or Group Drive

On very large work where it is cheaper to move the machine tools to the work than to move the work to the machine, individual drive is, of course, indicated. Any machine that takes 25 hp. to 50 hp. or more, and operates at a fairly uniform load not far from full load, particularly if the speed is high, should be considered for individual drive. In some special applications involving very frequent stops, starts, reversals, or speed variations, the controlling of which absorbs a considerable part of the operator's time, group drive is ruled out, due to the convenience of the electric control which makes possible a saving in time over mechanical control, and the fact that the clutches, brakes, etc., necessary to give a comparable operation would require more repair, or give decreased reliability. In the great majority of applications either group or individual drive can be used.

In most discussions of this subject it is stated that the power consumed is much less with individual drive. From experience the difference has been more fancied than real. It is true that in the old days when an entire group of buildings was driven from one large engine with belts in tunnels from basement to basement, massive main shafting, bevel gears, or large quarter turn belts to turn corners, and all the complication of old time millwrighting, losses in power transmissions were ordinarily 30 per cent, and some time with poorly planned installations reached 50 per cent. With modern drives in groups of 7½ to 50, and occasionally (in case of heavy machines) 75 to 100 hp. a large number of tests made under the author's direction indicate an average loss including countershaft losses of 12½ per cent as ordinarily tested, with a probable actual loss in operation of 15 or 16 per cent. Of this loss only one-sixth was in the main line shafting. The remaining five-sixths was in the counter shafting.

On the other hand, if there is much overtime work in the shop involving the operation of a very few machines in a room, for many hours per year, overtime, with a group drive, the corresponding line shaft losses from operating the group line shafting for a few machines may show a decided loss in power as compared with individual drive. Similarly in an industry which is highly but not completely seasonal, where through a part of the year only a few machines are operated, a similar condition arises.

In a large highly organized shop where the inventory of work in progress is kept at a minimum to reduce investment in unfinished product, and where, therefore, a manufacturing delay of a few hours, or a day or two, in one part of the plant will throw many other departments out of step, reliability of motive power frequently outweighs considerations of first cost or power loss. In almost any plant this is true during periods of abnormal activity. There are many drives in most industrial plants which will cause loss out of all proportion to such costs if they are shut down for minutes or hours only.

Examples of such drives are pumps supplying cooling water to parts which will be destroyed in a short time without it, especially if long, expensive dismantling is required to make replacements. Such drives should be in duplicate, and when there is only one source of electric service available the spare should be steam, gasoline or Diesel engine driven.—*Industry Illustrated*, Sept. p. 48.

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KENNETH H. CONDIT AND FRED H. COLVIN, *Editors*

Going the Government One Better

THE proposal of the Eastern railroads to arrange themselves into four trunkline groups is an interesting one to anybody as showing how rapidly sentiment changes. A few years ago such a suggestion to a railroad president would have stunned him. When it was put forward by the Interstate Commerce Commission only a little while back it aroused intense opposition.

And now we have a scheme that makes a more drastic reduction in the number of big railroad systems than the economists of the Commission dared to hope for. If the plan is approved, as seems reasonable to believe, there is going to be a tremendous management job for some one. Much duplication of effort along many different lines can be eliminated, to the great advantage not only of the railroads but to those who sell to them as well.

When such consolidations are effected there will be no need for the many varieties and types of cars and locomotives that are now on the rails. Manufacturers can concentrate their attention on larger orders for standardized equipment and the saving will be considerable. We are assuming, of course, that the breadth of vision that led the railroad executives to suggest the mergers will still be exercised when it comes to details.

As to the equipment manufacturers, there will be a great reduction in the number of purchasing agents to whom they must dispatch armies of salesmen, and the economy will be great. They will watch the progress of the plan with undivided attention.

The Underpaid Engineering Profession

ENGINEERS, technologists and men of science generally are, according to the *Saturday Evening Post*, among the most conspicuously underpaid people in this country. Such training costs money and takes brain and stamina to complete. Trained men who can plan out new work, develop new processes and advance industry in various ways are too valuable for the country to allow to be ground down.

It is to the discredit of any country that it allows men of this kind to be underpaid. Conspicuous examples of pitifully inadequate compensation may be found in Washington, the capital of the richest country of the globe. The salaries paid bureau scientists, faithful and valuable public servants though they be, would be scorned by a carpenter or mason. Similar men in private corporations receive more, but by no means enough to compensate them for their preparatory education or the results of their work.

Many managers of large corporations have realized this condition but as long as they could get men at the price they did not lose any sleep over it. The time has come, however, when the effect of this policy is beginning to be felt. Those whose business it is to secure these recruits for industry are complaining that the young men are not available as in the past. They report that educators are telling students the brutal truth about the remuneration likely to be had from engineering occupations. Engineers themselves are also advising young men against the professions. Scouts are being frankly told that the incentive offered must be greater to secure the kind of young men they need.

America has long been a leader in mechanical achievement. But unless we wake up to the necessity of preserving this leadership by making the engineering profession attractive to men of the higher type, we are in danger of losing it. At the time when the world is depending more and more upon science and engineering, it is utter folly to continue to underpay the kind of men who are so valuable to any country.

Unless the engineering profession can be assured of adequate compensation we are in danger of losing much of our prestige in various industrial lines.

What Is a Used Machine Tool Worth?

WHEN you take your automobile of more or less ancient vintage and offer it as part payment on a nice new shiny one, the dealer quickly thumbs the pages of his Blue Book and tells you the precise market value of your faithful vehicle according to the average of the leading markets. If you have kept yours in better than the average condition the dealer will then allow you something additional for your care.

When you call a machine tool dealer in to look over a tool that still has years of service in it but which you wish to replace with a more productive tool what does he do? Does he produce his Blue Book of machine tools and give you some cold figures? He does not. Most likely he starts out by pointing out the defects in your tool and gradually leads up to what he will allow, sparring for time in hopes that you will give a hint as to what you might take. And then you haggle back and forth and end up by neither being satisfied and no deal is consummated.

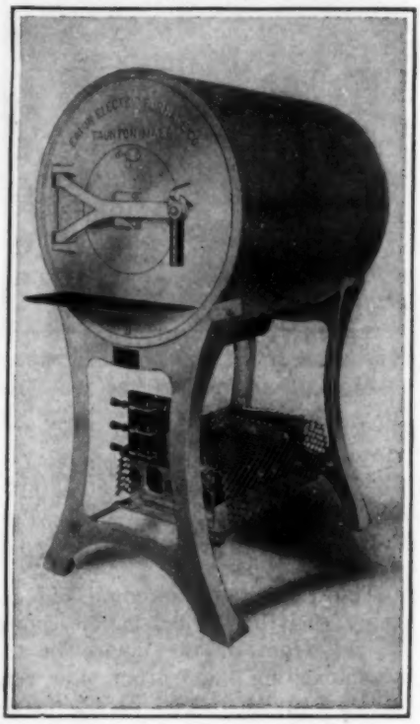
If some sort of a base depreciation value could be established on used machine tools new markets would be opened for the manufacturers because their dealers and the users could get together much easier. Take for instance lathes. A depreciation could be established for each year based on the current market price, not the original purchase price. A lathe that cost a thousand dollars four years ago would depreciate the same per cent that a lathe that cost seven hundred dollars would, conditions being the same. The lower priced lathe would always remain the lower priced. If one had better care than the other that would make a difference that the dealer could determine.

The principal thing is to get some definite basis on which to work. We have appraisal standards for other commodities. There should be one for used machine tools. When there is one the buyer, the dealer and the manufacturer will all profit by it. Discussion of the question will be welcome.

Shop Equipment News

Eaton Electric Hardening Furnace

The Eaton Electric Furnace Co., Taunton, Mass., has just brought out a furnace designed primarily for the purpose of hardening carbon-steel tools and dies and for the temper drawing of high-speed steels. It is adapted for the requirements of the average machine shop or toolroom and for the production hardening of small tools.



Eaton Electric Hardening Furnace

The furnace is cylindrical in shape and is mounted in a horizontal position at a convenient working height from the floor. The heating unit is a cylindrical shell of carborundum, around the outside of which the resistance coils are wound. The rear end of the heating chamber is closed by a plug that is easily removable to provide access to the heating unit. The unit is entirely independent and may be taken out for inspection or replacement by merely disconnecting the leads.

The outer wall of the furnace is a steel plate lined with 6 in. of insulating material. The internal walls are of fire brick and the loading shelf is of carborundum. The space between the door and the heating chamber is 9 in. deep and is provided with a pocket for the reception of powdered charcoal to prevent the excessive oxidation of the heated work when the door is opened. A tubular opening in the door, closed by a sliding cover, allows the operator to inspect the charge without opening the door. A small opening in the rear plug provides for the introduction of a thermocouple.

The control panel is a shelf located between the supporting legs below the furnace and within easy reach of the operator. The control is by means of three single-pole, double-throw switches, giving seven combinations of resistance corresponding to temperatures ranging from 1,400 to 1,800 deg. F. The current consumption varies from 3.3 to 14 kilowatts.

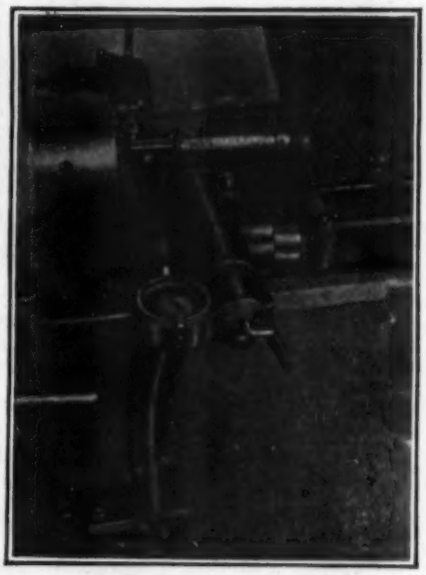
The heating chamber is 9 in. wide, 15 in. long and 7 in. high. The capacity as a production furnace is approximately 100 lb. per hr. The furnace occupies a floor space 30½x 39 in., and weighs 1,350 pounds.

Sizing Indicator for Bryant Chucking Grinder

A continuous size-indicating attachment has recently been brought out by the Bryant Chucking Grinder Co., Springfield, Vt., to be used in connection with its machines on production work. The use of the device enables the operator to know when the exact diameter of hole has been reached without the necessity for constant plug gaging. It is entirely independent, and may be attached to any standard Bryant hole grinder. When in position it does not interfere with the movements of the operator.

The device consists primarily of a dial indicator, a diamond gaging point to rest in the bore of the hole being ground, and means for communicating the movement of the gaging point to the dial of the indicator. All working parts, including the dial, are enclosed to protect them from water and grit. A glass cover is fitted over the dial.

The gaging point is a diamond, smoothly finished to the radius of the smallest hole to be ground and carried on a small arm that projects into the hole. The whole device is movable endwise by means of a lever, so that the gaging arm may be instantly withdrawn from the hole and swung up out of the way when changing work pieces.



Sizing Indicator for Bryant Chucking Grinder

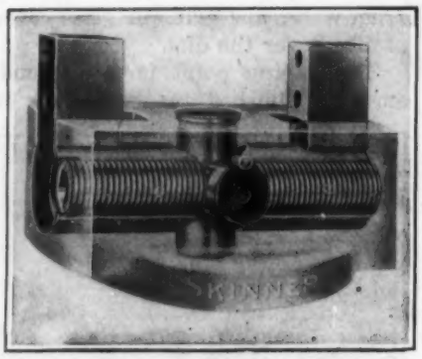
After the grinding wheel has been started in a piece of work the device is advanced until the arm enters the hole and the diamond rests against the wall of the hole opposite the wheel. The dial, previously set to the size of hole required, immediately registers the number of thousandths that the hole is smaller than the nominal size.

The diamond remains in contact with the wall of the hole throughout the grinding and, as the diameter of the hole approaches the nominal size, the pointer of the indicator falls toward zero. When the zero mark is reached, the operator knows that the hole is of the required size

and he has only to withdraw the grinding wheel and take out the work. No plug gaging is necessary.

Skinner "Box-Body" Two-Jaw Chuck

The Skinner Chuck Co., New Britain, Conn, has added to its line the two-jaw lathe chuck shown in the accompanying illustration. The chuck is especially adapted for production work on odd-shaped pieces and is designed for use on turret



Skinner "Box-Body" Two-Jaw Chuck

lathes and other similar machines.

The feature of the chuck is the design of the jaws, the bearing parts of which are cylindrical in shape and fit smoothly into a round hole through the body. The chambers in which the jaws slide are slotted through to the face of the chuck for a short distance only, thus leaving the central portion entirely closed.

By reason of this construction the jaws have a full bearing in the body of the chuck in all positions, and it is claimed that there can be no tendency for the hole to wear bell-mouthed from continued service. More than ordinary rigidity is also claimed because of the fact that the bearings extend to the outer ends of the jaws.

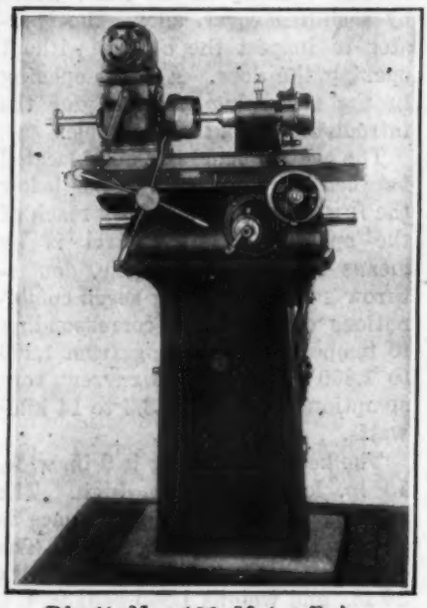
The screw is a single piece of chrome-nickel steel, hardened and ground. The strain upon the screw is balanced, and it therefore exerts no end thrust in either direction. A hardened and ground plug, entered from the side of the body, partly encloses the reduced shoulder between the threaded portions and retains the screw in its central position.

The axial hole through the chuck body is fitted with a steel bushing to pilot the tools employed or provide clearance for a shank upon such work as may require it. The bushing also prevents dirt or chips from working into the threads of the screw or bearings of the jaws. The chuck is attached to the spindle of the machine by a faceplate or adapter. Screw holes in the jaw extensions provide for the attachment of slip-jaws, fitted to the particular work in hand. The chuck is made in 7½- and 9-in. sizes.

Rivett No. 103 Motor-Driven Internal Grinder

The Rivett Lathe & Grinder Corp., Brighton district, Boston, Mass., has redesigned its No. 103 internal grinding machine to adapt it for an individual motor drive. The redesigned machine incorporates all the essential features of the original machine, but changes have been made in the work head and wheel spindle.

A ¼-hp. constant-speed motor is now mounted directly upon the work



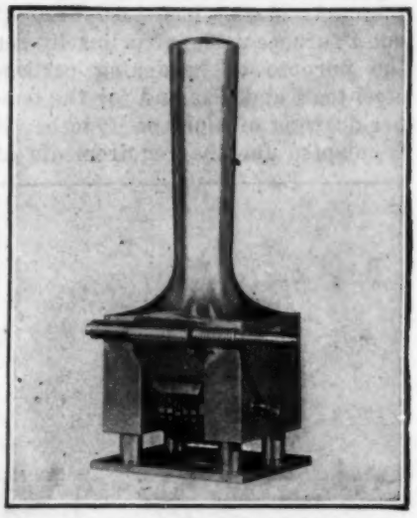
Rivett No. 103 Motor-Driven Internal Grinder

head and drives the work-carrying spindle through a train of spur gears and a worm and wormwheel. A gear shift transmission is interposed in the drive to give two spindle speeds. A friction clutch, operated by a hand lever, allows the spindle to be stopped and started without shutting down the motor.

A 3-hp. constant-speed motor mounted at the rear of the machine base drives the wheel spindle, table movements and pump. The drive in this case is by means of a silent chain to a jackshaft, upon which there are fixed pulleys and cones to provide necessary changes of speed. The chain, jackshafts and belts are covered by suitable rigid guards. The motors are controlled by means of push buttons mounted on the front of the column within easy reach of the operator.

American Model P-2 Metal Numbering Machine

An improved model of numbering machine has recently been added to the line of such equipment manufactured by the American Numbering Machine Co., Atlantic and Shepherd Aves., Brooklyn, N. Y., and has been designated model P-2. The



American Model P-2 Metal Numbering Machine

device is like the model P-1, previously described on page 306, Vol. 60, of the *American Machinist*, except that it is fitted with semi-automatic means for setting the number wheels.

The setting is accomplished by depressing the pivoted handle shown at the front of the device in the accompanying illustration. For consecutive numbers the handle is depressed after each number is made. The number is imprinted by placing the machine on the work and striking the shank a blow with a hammer.

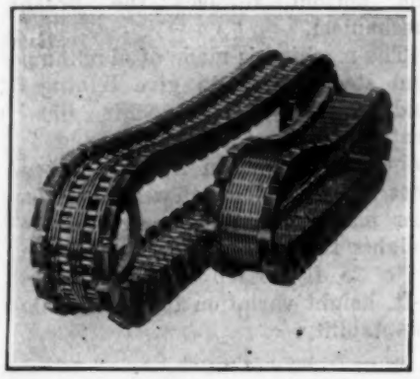
Reeves Steel-Link V-Belt

The most important part of the variable-speed transmission made by the Reeves Pulley Co., Columbus, Ind., is the V-belt that transmits the power between the constant-speed and variable-speed shafts. In order to secure increased durability and flexibility in this portion of the mechanism a steel-link belt has recently been developed by this company.

The steel belt can be applied to either new or old transmissions, since its over-all dimensions are the same

as the rubber-body belt heretofore supplied with all Reeves transmissions. The chain is composed of hardened steel links connected by anti-friction rocking pins. It is a modification of a standard silent chain belt, strengthened by steel cross-pins to withstand the pressure of the transmission cones of the mechanism when in operation.

Leather tabs are cemented and riveted to small steel plates securely fastened to the body of the belt. These leather pieces make contact

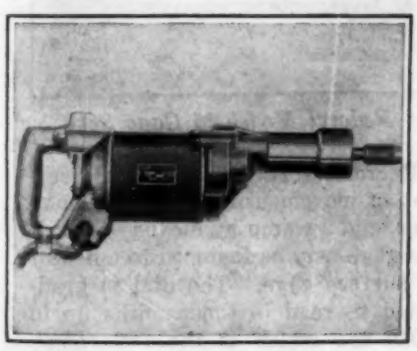


Reeves Steel-Link V-Belt

with the transmission cones and are fastened to the belt at the proper angle. It is said that the steel belt is quiet in operation and that it runs smoothly and evenly at all positions of the transmission disks. No tools are required to install the belt on a transmission. An oil cup for lubricating the belt can be attached to the frame of the mechanism and a suitable oil casing can be furnished.

Hisey Friction-Head Electric Screwdriver

The friction-head electric screwdriver recently placed on the market by the Hisey-Wolf Machine Co., Cincinnati, Ohio, has sufficient capacity



Hisey Friction-Head Electric Screwdriver

to drive No. 14 screws, 2½ in. long, in solid soft wood. When suitable lead holes are provided, large wood screws and lag screws up to ⅝ in. in diameter and 4 in. long can be driven. The machine can also be used for setting nuts, for which sockets in ¼-, ⅜-, and ½-in. sizes can be furnished for square and hex nuts.

The driving head is equipped with a disk friction clutch that is automatically regulated by the pressure applied. The clutch casing is of convenient size and can be used as an end grip when the work requires it. A quick cable connector that obviates the necessity of dismantling the machine to replace the cable is provided. The switch is conveniently located in the handle. The tool can be supplied with universal motors to run at 115 or 230 volts. The spindle runs at 525 r.p.m. with no load.

A screw-slot finding attachment can be furnished to obviate the danger of the driving bit slipping out of the slot and spoiling the work. These are made in three sizes. Special machines to run on voltages from 32 to 250 can be furnished on order.

Spring Grove Portable Woodworking Saw

A recently marketed product of the Spring Grove Tool & Manufacturing Co., Spring Grove, Pa., is an electric portable combination wood-

Spring Grove Portable Woodworking Saw

working saw. The machine is equipped with a Wagner ½-hp. motor that drives the saw at 3,400 r.p.m., and has sufficient capacity to cut wood up to 2 in. thick.

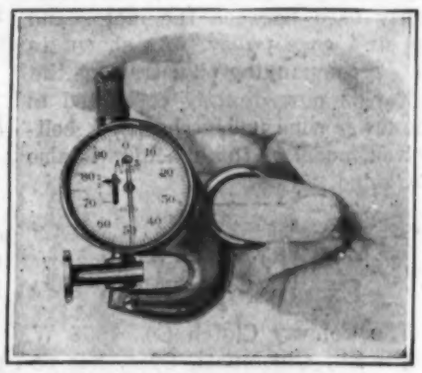
The 24x24-in. table is made of cast iron and has provision for the addition of wooden extensions on either side if needed. The table can be tilted through an angle of 45 deg. and locked in any position. A cut-off and miter guide can be used on either side of the saw. The ripping fence will accommodate material up to 12 in. wide.

The saw spindle and motor mounting are raised and lowered as a unit by the handwheel at the front of the machine. This arrangement allows the use of a dado head that is 1 in. wide and will cut grooves 2 in. in depth. The spindle has an extension that can be used for boring or drilling. The frame is of hard wood and all wearing parts are of metal.

Ames Pocket Thickness Gage

A recent addition to the line of micrometer dial gages manufactured by the B. C. Ames Co., Waltham, Mass., is a pocket thickness gage. The instrument is very compact and reads in thousandths of an inch.

The frame is of bronze and has a



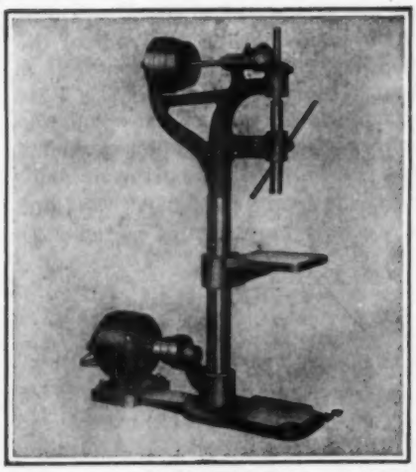
Ames Pocket Thickness Gage

ring through which a finger may be inserted to hold the gage, while the thumb and forefinger are used to open and close the jaws, as shown in the accompanying illustration. The dial is 1½ in. in diameter. The jaws are hardened and ground, the bottom one being adjustable in the frame to set the dial pointer at zero. The upper jaw is attached to the spindle of the micrometer.

The large pointer records the reading in thousandths and the small pointer indicates the number of revolutions made by the large one. The gage has a capacity of ⅝ in. A dial at the back of the gage gives decimal equivalents for fractions. The instrument weighs but 5 ounces and is adapted for the measurement of sheet metal, wire, small machined parts, paper, etc. Both dials are suitably protected by crystals.

Buffalo Improved Three-Speed Bench Drill

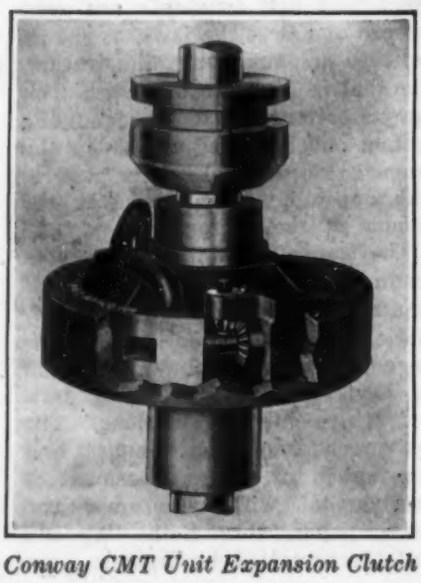
The Buffalo Forge Co., 490 Broadway, Buffalo, N. Y., has recently improved the driving mechanism of its three-speed bench drill by eliminating the spur gears that were formerly used between the motor and the first cone pulley. As shown in the accompanying illustration the motor is now directly connected to the lower cone pulley shaft. A belt-driven model of this machine is also marketed.



Buffalo Improved Three-Speed Bench Drill

Conway CMT Unit Expansion Clutch

The Conway Clutch Co., 1956 W. Sixth St., Cincinnati, Ohio, has recently placed on the market the friction clutch shown in the accompanying illustration. The features of the device are a self-contained friction unit, accessible adjustment with wide range, large peripheral contact and full-length bearing for the loose member.



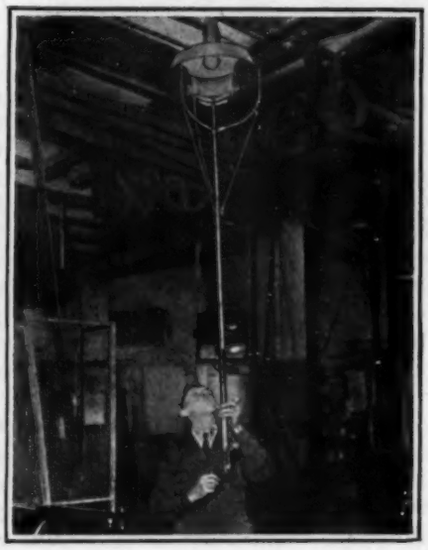
Conway CMT Unit Expansion Clutch

The friction unit carries an adjustable latch, with which a bent lever makes contact and causes the friction unit to expand when the lever is operated by means of the usual type of sliding cone. The friction unit is keyed to the shaft and is so machined that it will make suitable contact when engaged and spring away quickly when disengaged. The clutch is adjusted by turning the squared shaft to which the pinion of the latch mechanism is attached. In the accompanying illustration the outer member is cut away to show the latch-adjusting apparatus.

The clutch is marketed in a sleeve type, a clutch pulley type, and as a close-coupled clutch. When a double unit is desired a double-end operating cone is supplied. The device is manufactured in sizes from 6 to 12 in., with a power range up to 25 hp. at 100 r.p.m. Clutch pulleys can be furnished in all sizes up to 24 in. in diameter.

Electric Light and Reflector Cleaner

A hand-operated mechanism for cleaning electric lights and reflectors that are located far from the floor is now being marketed by the Electric Light & Reflector Cleaner Co., Appleton, Wis. The cleaning is done by the operator while standing on the floor, so that there is no danger of falling from high stepladders or getting caught in nearby belts or pulleys.



Electric Light and Reflector Cleaner

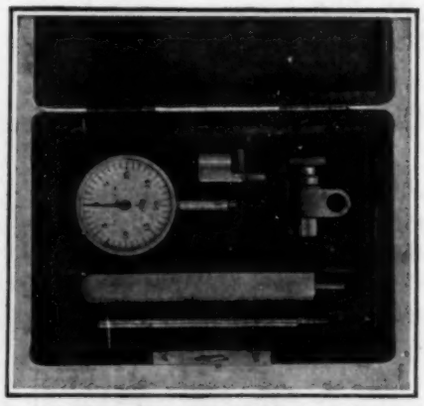
The apparatus consists of a set of telescoping tubes, the upper tube controlling the three arms that grip the reflector under spring tension and prevent it from turning. The inner tubes control the brush mechanism. The handle at the bottom raises the mechanism into contact with the reflector and lamp, while the lever at the side of the handle holds the brushes against the surface to be cleaned. The crank at the bottom revolves the brush mechanism.

The machine is made of aluminum and steel tubing to give lightness and durability. The machine illustrated weighs four pounds and is being used to clean a reflector ten feet from the floor. Twelve lengths are manufactured to accommodate heights from the floor varying from 7 to 25 ft. Each machine has a 2-ft. height variation to increase its adaptability.

Federal Model 25 Gage Set

The Federal Products Corp., 15 Elbow St., Providence, R. I., has brought out a small pocket gage set especially adapted to the use of toolmakers and others who have occasion to set up work on the lay-out plate or machine table.

The set consists of a dial gage, a bell crank for changing the direction of movement, suitable extension rods, and a clamp by means of which the gage may be fastened to a height or surface gage. The dial is graduated to read in thousandths up to 0.040 in., which is the full range. The dial is 1 in. in diameter. The set is put up in a leather case of convenient size to be carried in the pocket of the operator as shown in the illustration.



Federal Model 25 Gage Set

News of the Week

Standardization Work Is Featured at Meeting of Gear Manufacturers

Pittsburgh chosen for the next meeting to be held in May

Standardization was given further impetus at the semi-annual meeting of the American Gear Manufacturers' Association held at Briarcliff Lodge, Briarcliff Manor, New York on the 16th, 17th and 18th of this month. President George L. Markland, Jr., of the Philadelphia Gear Works, in the opening address emphasized the importance of standardization and urged the tireless co-operation of all. He pointed out that standardization is bound to come and that the A.G.M.A. is the logical group to do the work.

The reports of the General Standardization Committee and the Sectional Committee of the American Engineering Standards Committee, presented by B. F. Waterman of the Brown & Sharpe Manufacturing Co., Chairman, showed that appreciable progress has been made. Discussion brought out the fact that the association has been appealed to by European countries for information. The A.G.M.A. has its chance to continue to lead the world in gear standardization, he stated.

In giving the report of the A.G.M.A. representatives of the A.S.M.E. Research Committee on Gears, E. W. Miller of the Fellows Gear Shaper Co., emphasized the necessity of having data secured from tests in order to show the results of gear standards and told about the progress being made in the construction of the Lewis machine designed to test the effects of speed and load upon gear teeth. The machine is nearing completion in the Bilgram Machine Works, Philadelphia, and the plan is to run the tests at the Massachusetts Institute of Technology.

New Members Elected

Three companies were elected to membership. The names of the companies and their representatives in the association are: The Cleveland Worm & Gear Co., Cleveland, Ohio, Howard Dingle, executive representative; the Dodge Manufacturing Co., Mishawaka, Ind., D. J. Campbell, executive representative; and the Farrel Foundry & Machine Co., Buffalo, N. Y., W. E. Sykes, executive representative. Two associate members from the W. A. Jones Foundry & Machine Co., Chicago, Ill., were added, namely, William F. Coleman and Leslie C. Meyer.

During the three days of the meetings reports were received from the following committees:

Public Policy Committee; chairman, H. E. Eberhardt, the Newark Gear Cutting Machine Co.

Publicity Committee; chairman, J. C. McQuiston, the Westinghouse Electric & Manufacturing Co.

General Standardization Committee and A.G.M.A. Sectional Committee of the A. E. S. C.; chairman, B. F. Waterman, the Brown & Sharpe Manufacturing Co.

Committee on New Applications for Gears; chairman, T. C. Roantree, the Westinghouse Electric & Manufacturing Co.

Uniform Cost Accounting Committee; chairman, R. C. Ball, the Philadelphia Gears Works.

Library Committee; chairman, E. J. Noble, the Horsburgh & Scott Co.

Commercial Standardization Committee; chairman, E. A. Kebler, the Fawcus Machine Co.

Spur Gear Committee; chairman, J. L. Williamson, the Fellows Gear Shaper Co.

Transmission Committee; chairman, A. P. Emmert, the Warner Gear Co.

Differential Committee; chairman, S. O. White, the Warner Gear Co.

Bevel and Spiral Gear Committee; chairman, F. E. McMullen, the Gleason Works.

Nomenclature Committee; chairman, E. W. Miller, the Fellows Gear Shaper Co.

Tooth Form Committee; chairman, H. J. Eberhardt, the Newark Gear Cutting Machine Co.

Gears and Pinions Committee; chairman, W. H. Phillips, the R. D. Nuttall Co.

Herringbone Gear Committee; chairman, A. F. Cooke, the Fawcus Machine Co.

Sprocket Committee; chairman, G. M. Bartlett, the Diamond Chain & Manufacturing Co.

Worms and Worm Gear Committee; chairman, J. C. O'Brien, the Pittsburgh Gear & Machine Co.

Non-metallic Gearing Committee; chairman, F. G. Sorensen, the Cincinnati Gear Co.

Keyway Committee; chairman, L. G. Nilson, the Nilson-Miller Co.

Inspection Committee; chairman, F. G. Eppley, the Albaugh Dover Manufacturing Co.

Metallurgical Committee; chairman, C. B. Hamilton, the Hamilton Gear & Machine Co.

Industrial Relations Committee: chairman, E. S. Sawtelle, the Tool Steel Gear & Pinion Co.

Almost all of the reports of committees were progress reports. Of particular interest is the information gathered from the report of the Tooth Form Committee to the effect that from tests already made it is believed that it is practical to make gears which will interchange, although cut on machines of different makes, using different processes. It was pointed out that the time is approaching when gears cut with a disk cutter, a hob or by the planing method can be made to interchange with each other.

The progress reports showed that a great deal of work has been done since the last meeting and indicated that a large number of standards will be offered for approval and acceptance at the next meeting.

A pleasing feature connected with the standardization work at this meeting was a note of confidence given B. F. Waterman, chairman of the General Standardization Committee. The tribute was well deserved, as Mr. Waterman, more than anyone else, is responsible for the results in standardization brought about by the association. Not only does Mr. Waterman's interest never flag but he is a tireless worker.

Papers Presented

The papers presented were:

"New Gear Applications," by T. C. Roantree of the Westinghouse Electric & Manufacturing Co.

"Shop Costs," by Thomas Haley, of the Fawcus Machine Co.

"Spur Gear Speed Reducers, What Are They? Why and Where Are They Used?" by Warren G. Jones of the Jones Foundry & Machine Co.

"The Trend of the Transmission," by W. A. McCarrell (read by S. O. White of the Warner Gear Co.).

"How Are Our Future Mechanics to Be Trained?" by Erik Oberg, editor of *Machinery*.

The paper by Mr. McCarrell described a constant-mesh transmission known by the name McCarrell and said to combine silence, ease of operation, and ease of production.

A paper that proved of great interest was that of T. C. Roantree on the subject, "New Gear Applications." In urging members of the association to seek new fields for gears, Mr. Roantree showed the fitness of gears for further applications by referring to their improved quality. He said, "There is no question that we are producing today a gear far superior in every way to the gear we produced as recently as five or ten years ago. The advancement in heat-treatment of gears has been correspondingly great. Our methods of the inspection and testing of gears for physical properties and accuracy of tooth form, spacing, and proportion, have reached such an advanced stage that not only do we assert that our gears are correct—we can prove it."

Mr. Roantree spoke on findings of the

scientists concerning the benefits of quiet gears and referred to the work done by manufacturers of gears and makers of machinery toward producing quiet-running gears.

He referred to standardization in this way: "Our work on standardization should bring out the point to the ultimate user that the greater efficiency of the gear in every respect is but one feature, and that another feature which should appeal to him is the possibility of readily obtaining a duplicate for replacement, should occasion so require."

There were pointed out also in Mr. Roantree's paper the fields offered by mechanical means now replacing labor, the growing use of direct motor drive, improved mechanical devices in agriculture, and mechanical devices for strict domestic use.

Haley on Shop Costs

Thomas J. Haley of the Fawcus Machine Co., in his paper, "Shop Costs," treated the subject from a statistical point of view. He said in part: "Correct uniformity of costs, to the establishment of which practically all recent cost studies have been directed, is an educational activity, and like all such movements, requires long and careful consideration before adoption. . . .

"I do not believe that any system of records has been devised to entirely supplant human sagacity on the part of successful industrial executives, but on the other hand, industrial history is replete with failures that might have been avoided had obtainable data been compiled and used as a guide in the conduct of business.

"The member company with which I am connected uses what is considered a sound and practical method of recording shop and complete costs. Labor is charged direct to the jobs in production. Shop overhead cost, which is under direct control of the operating executive at the time of the incurring of the expense, is pro-rated over jobs on the basis of pre-determined rated machine hours.

"Rated machine hours are determined by a survey of the entire plant and equipment and the subsequent classifying of producing machine and facilities on the basis of their relative position to the whole scheme of operations. The cost includes depreciation on buildings and equipment, insurance and rent, all apportioned by square feet of floor space occupied; power cost apportioned by rated hp. and small tool expenses at cost.

"Cost other than shop cost is under the direct control of the managing executive and is pro-rated over operations on the basis of productive hours. The total cost thus obtained is assembled monthly on the job unit basis and is referred to the various departments for examinations and guidance in future activities.

"The primary essential of a cost system, of course, is completeness, and this is obtained only by positive ledger control of items making up the cost structure and is easily established by proper accounting methods.

"The gear industry has maintained and always will maintain a permanent place in the mechanical arts. The members of this association, realizing this, have banded themselves together to the end that, by common consent and cooperation, this industry might prosper and be kept abreast of modern advancement in the technical field.

"To maintain and accomplish these purposes, correct shop cost is one of the important factors demanding careful supervision and proper application."

Mr. Haley suggested finding out by questionnaire the information desired by member companies so that the cost committee can formulate and recommend sound and uniform methods of finding, recording and using cost data.

Arthur J. Baldwin, vice-president of the McGraw-Hill Co., Inc., talked about business in the United States and abroad. He pointed out that business consists of supplying the wants of mankind and showed that increased business will come when the wants of the world are increased. Such increases will be brought about by raising the standard of living, particularly in European countries. Greater production per capita can be accomplished by more intelligently directing the workers and by giving them better and more productive machinery.

Mr. Baldwin referred to Germany's situation, saying that she already had the desire for more things and through loans is now getting the money to buy them. The talk struck a responsive chord and was frequently the subject of discussion by small groups during the remainder of the meeting.

A feature of the semi-annual meeting was an afternoon of golf. R. P. Johnson of the Warner Gear Co. won the cup given by the *American Machinist*. Second prize, a golf bag, was won by Richard J. Henritze of the Westinghouse Electric & Manufacturing Co., third prize, a golf club, by G. Swallow of the Diamond State Fibre Co., and fourth prize, a dozen balls, by F. W. England of the Illinois Tool Works.

The next meeting, which will be the ninth annual meeting, will be held in Pittsburgh in May.

Record Attendance at Annual Meeting of Foundrymen

Lewis W. Olsen is elected president of the association

For enthusiasm, attendance, number of exhibits and results obtained, the twenty-eighth annual meeting of the American Foundrymen's Association, Inc., that was held in conjunction with the Institute of Metals Division of the American Institute of Mining and Metallurgical Engineers at the Auditorium in Milwaukee, Wis., Oct. 11 to 16, inclusive, broke all records. The total registration was nearly 5,200 as compared to the previous high mark, which was 3,850. There were 215 exhibits, the entire available space of 55,228 sq.ft. being occupied. A large number of the exhibits included mechanical equipment under power, all operating equipment being located in the basement. Connections were easily made for electric current and the air compressors that were included in the exhibits furnished air for molding machines, air hammers, drills, sand blast equipment, etc.

The exhibits comprised foundry equipment of all kinds; molding machines, cranes and hoists, furnaces, crucibles, flasks, sands, core-oils, sand-blasting machines, metals, graphite, plumbago, meters, shop trucks, shop barrels, disk grinders, saws, saw filing and setting machinery, welding and cutting torches, flooring, air compressors, air drills, air hammers and grinders, belt lacing machines, core ovens, work benches, pattern making machinery, fluor spar ore, magnetic separators, ball bearings, sand mixers, grinding wheels and abrasives, claplets, foundry coke, blowers, foundrymen's shoes, goggles, etc., foundry nails, pig iron, steels, coal, sand sifters, engraving machines, lathes, milling machines, drill presses, grinding machines, and exhibits comprising photographs to illustrate building construction, coal-firing units, etc.

The convention opened Saturday, Oct. 11, with the registration and opening of the exhibits. The first technical session—a joint meeting of the A.F.A. and the A.I.M.E. was held Monday afternoon, at which the subjects of "Non-Ferrous Metals" and "Annealing Steel Castings" were discussed. The Institute of Metals Divison of the A.I.M.E. held an alumni dinner at the Hotel Pfister in the evening. Other subjects discussed throughout the week were, "Aluminum Alloys," "Steel Founding," "Apprentice Training," "Foundry Sand," "The Electric Furnace and Cast Iron," "Malleable Cast Iron," "Cast Iron," "Brass Founding," and Foundry Costs."

Founders Are Prepared

At the business session of the A.F.A. Wednesday afternoon, H. Cole Estep, who is a well-known member of the organization said, "American foundries could mobilize their resources in less than a month to turn out millions of bombs and grenades in the event of another war. We have learned to profit by our experience in 1917 and the lesson was a costly one. It was to avoid the possibility of a recurrence of such a condition that the foundries were asked by Judge Elbert H. Gary to make an estimate of their capacity for producing munitions." Mr. Estep declared that the foundries took an important part in defense day plans, and that since defense day, a complete organization has been formed to meet the situation if war should threaten. The group is captained by the owners and executives of the largest foundries in the United States. Certain varieties of shells, together with bombs and rifle and hand grenades could be produced in great qualities within a week after war was declared.

The apprenticeship program was supplemented by an actual working demonstration of the apprenticeship department of the Falk Co., Milwaukee, which had an exhibit at the convention hall. Inspection trips tc plants operating apprentice departments were also arranged and an apprentice competition was held in the foundry of the Milwaukee Vocational School in which both grey iron and steel foundry apprentices took part.

The annual banquet of the association was held Wednesday evening at the Hotel Pfister, with G. H. Clamer, president of the association, acting as chairman. The principal speaker was Dr. G. W. Dyer, professor of political economy at Vanderbilt University, Nashville, Tenn. Dr. Dyer spoke on "The Responsibility of Leadership under the American Constitution." The election of officers for the ensuing year took place Thursday with the following results; President, Lewis W. Olsen, works manager, Ohio Brass Co., Mansfield, Ohio; Vice-President, A. B. Root, Jr., Hunt-Spiller Manufacturing Corp., Boston, Mass.; Director for one year, V. E. Minich, president, American Foundry Equipment Co., New York. Directors for three years: A. E. Hageboeck, Frank Foundries Corp., Moline, Ill.; W. J. Nugent, Nugent Electric Steel Foundries, Chicago, Ill.; R. A. Nourse, Stowell Co., Milwaukee, Wis.; John A. Galvin, Ohio Steel Foundries, Lima, Ohio. The secretary-treasurer will be elected by the board of directors at its next meeting. This office has been held for several years by R. E. Kennedy, Urbana, Ill.

Industrial Advertisers Meet in Chicago

Subjects of unusual interest to industrial advertisers were the basis of the two-day meeting of the National Industrial Advertisers' Association held Oct. 13 and 14 at the Edgewater Beach Hotel, Chicago. Men of national prominence were in attendance and the speakers had been selected with care so that a diversity of subjects was brought out.

Ezra W. Clark, president of the Engineering Advertisers Association, Chicago, delivered the address of welcome and President P. C. Gunion of the association responded.

Among the speakers heard were the following: G. D. Crain, Jr., publisher of *Class;* Malcolm Muir, vice-president, the McGraw-Hill Co.; Cyrus McCormick, Jr., president, the International Truck Co.; E. St. Elmo Lewis, vice-president, the Campbell Ewald Co., C. B. Cook, the Elwell Parker Electric Co., Cleveland; P. L. Thomson, the Western Electric Co., New York; W. S. Dorsey, assistant general manager of sales, the McMyler-Interstate Co.; A. H. Oberendorfer, Sivyer Steel Castings Co., Milwaukee; George F. Climo, the Brown Hoisting Machine Co., Cleveland; W. A. Grieves. the Jeffrey Manufacturing Co., Columbus, Ohio; T. H. Bissell, the International Nickel Co., New York; George W. Morrison, the Ingersoll-Rand Co., New York; F. R. Davis. the General Electric Co., Schenectady; Russell T. Gray, Russell T. Gray & Co., Chicago; Julius S. Holl, the Link Belt Co., Chicago; W. W. French, the Dodge Manufacturing Co., Mishawaka, Ind.; R. C. Beadle, the Combustion Engineering Co., New York; Max Berns, the Universal Portland Cement Co., Chicago; J. R. Hopkins, the Chicago Belting Co., Chicago; J. D. Pease, the Penton Publishing Co., Cleveland; Edwin L. McFalls, the Master Builders Co., Cleveland; R. F. Wood, the Autocar Co., Ardmore, Pa.; E. J. Smythe, the Fuller & Johnson Manufacturing Co., Madison, Wis.; Stanley Resor, president, the J. Walter Thompson Co., New York; Keith J. Evans, Joseph T. Ryerson & Son, Chicago; G. W. Brogan, the Black & Decker Manufacturing Co., Towson, Md.; L. F. Hamilton, the Walworth Manufacturing Co., Boston; Bennett Chapple, the American Rolling Mill Co., Middletown, Ohio; R. E. Conder, the Boston Woven Hose & Rubber Co., Boston; and F. J. Maple, the Jno. A. Roebling's Sons Co., Trenton, N. J.

Roads Buy Heavily of Equipment

Headed by an order for 190,000 tons of steel rails for the New York Central R.R., purchases of the railroads throughout the country, as announced Oct. 15, totaled more than $17,000,000. This was one of the largest singie day's business in recent weeks and brings railroad purchases since the first of September to more than $100,000,000.

Of the New York Central order 87,000 tons will be rolled by the Carnegie Steel Co. and the Illinois Steel Co. Of the remainder 87,000 will be turned out from the plants of the Bethlehem Steel Corp. and 16,000 tons will come from the Inland Steel Co. The order amounts to about $8,000,000. The New York Central also placed orders recently with the Standard Steel Car Co. for 500 freight cars.

The largest equipment purchase announced during the day was that of the Texas & Pacific, which ordered 2,000 box cars from the American Car & Foundry Co. and the Pullman Co. The International-Great Northern Railroad Co. ordered 1,000 box cars from a Western builder whose name was not made public, and the Great Northern Ry. closed a contract for 500 ore cars with the Bethlehem Steel Corp.

Midwest Orders

According to word received from Chicago, steel mills in that district have received orders for 200,000 tons of car building material since the last week in August.

The Wabash has ordered 15,000 tons of rails for 1925 delivery, and the Erie will buy 8,000 tons for its Western lines. An order for 9,000 tons of tie plates has come from the Northern Pacific Ry., and the Norfolk & Western R.R. is getting bids on 10,000 tons of shapes and plates for 1,000 cars to be built in its own shops.

Seven electric locomotives of a new type have been ordered by the New York, New Haven & Hartford R.R from the General Electric Co. They will use both alternating and direct current. Each will be a "traveling substation" capable of picking up the alternating current of 11,000 volts from the overhead wires and changing it to the direct current used to operate the driving motors.

Additional orders for equipment and steel were placed by the New York Central also. One was for fifteen locomotives, placed with the American Locomotive Co., and including five pacific type engines, weighing 297,000 lb each and ten pacific type, weighing 306,000 lb. each.

Ford Company Will Build Australian Plant

Details of a far-reaching plan that involves the expenditure of millions of dollars by the Ford Motor Co. of Canada, Ltd., have been announced by Wallace R. Campbell, vice-president and treasurer of the corporation. It is the establishment of the Ford Motor Co. of Australia, with a capitalization of $5,000,000, the setting up of five assembling plants and a body plant with a fixed investment of approximately $3,800,000, and the spending of a similar amount for floating materials.

The company's move has been under consideration for nearly two years, and by easy stages has been brought to the point of consummation. Parties of Ford executives and staff men, headed by Philip W. Grandjean and Hubert C. French, secretary and assistant sales manager, respectively, are leaving for the Antipodes very shortly.

Announcement is made that the London, Ontario, plant of the Ford Motor Co. of Canada will re-open within the next couple of weeks. The company closed the London plant some months ago, shipping its machinery to South Africa. Now it is to be re-established on a larger scale than ever.

Stutz Will Build New Taxicab

Articles of incorporation have been filed with the secretary of state of Indiana for the H. C. S. Cab Manufacturing Co. of Indianapolis, and capitalized at $1,000,000. Harry C. Stutz is president of the new corporation and Henry F. Campbell, secretary-treasurer. Other officers of the company will be announced later.

The new organization takes over the assets and property of the H. C. S. Motor Car Co., which has a large plant in Indianapolis and in which the H. C. S. automobile, designed by Harry C. Stutz, has been in production.

Taxicabs of a medium-price and medium-sized type are to be the major interest of the new company, although the H. C. S. cars are to be continued. It is expected that the new cabs will be in full production by the latter part of November and that ten machines would be the daily average.

The Business Barometer

This week's outlet in Commerce, Finance, Agriculture and Industry based on current developments

By Theodore H. Price
Editor, *Commerce and Finance*, New York

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THE week's developments make it necessary to consider the business outlook internationally as well as nationally. The success of the German loan, which was ten times oversubscribed, is not surprising. The market had been carefully groomed for it and the auspices under which it was brought out guaranteed a wide distribution. That it will be the precursor of many other foreign loans seems certain and the average American is asking himself what will be the effect in this country.

It is undeniably true that in the long run we will help ourselves by helping others, but some think there is a possibility that the loans we make to Europe may put us at a temporary disadvantage by energizing our competitors in the world's markets. This is the view taken by the Rothermere papers in England. They have consistently opposed British participation in the money lending operations that are designed to put Germany on her feet and their opinion is shared by a few of our own bankers in the Middle West, who maintain that American capital should be reserved for the use of America.

But just at present this attitude is not popular in the United States, and there is a disposition to assume that we shall be benefited by European prosperity because it will mean a better demand for our cotton and grain as well as the other raw materials of which we produce an exportable surplus.

In proof of this contention it is pointed out that our September exports were valued at $427,000,000 as against $381,000,000 a year ago and that our imports were worth but $285,000,000, leaving a balance "in our favor" of $142,000,000, which is the largest shown for any month since the boom days of 1920.

As our net imports of gold in September were less than $2,000,000 it is argued that the large merchandise exports were made possible by credits arranged in anticipation of the German loan and that further loans mean further credits and further sales of our cotton and grain at high prices.

This is probably true, for there are many European communities that will be glad to borrow here on any terms, but sight should not be lost of the lower wage scale that prevails abroad and the curtailment of our industrial profits or production that will be necessary when the factories of Germany, Czecho-Slovakia, Poland and Austria are working full time and marketing their production at whatever it will bring. For them it is a case of work or starve, and we may be sure that we will have to work on this side of the Atlantic also.

But it will be some time before we commence to feel the spur of this competition, and meanwhile there is a confident expectation that we shall have a winter of prosperity if Coolidge is elected. This is an important "if" and the fear that the choice of a president may devolve upon the House of Representatives still persists. This fear was somewhat intensified by what Secretary Hughes said in his speech at Indianapolis on Oct. 13, and while there are many who believe that his purpose was entirely strategic the stock market was rather nervous all the week.

Bonds were also lower and many close students of monetary conditions think that we shall see higher interest rates by the end of the year. Call money is in fact somewhat dearer already, but it is quite possible that it may go back again when the flurry caused by the German loan has subsided. With a reserve ratio that stands at 77.1 per cent the Federal Reserve statement certainly gives no indication of any credit scarcity.

As to the political outlook itself predictions are worthless, but as I am in correspondence with many practical business men in the states commonly conceded to LaFollette it may not be out of order to say that most of them write me that it is unlikely that the Progressives will carry either Minnesota or Montana, without which the much feared deadlock would be impossible. The outlook is, however, an unusual one, and for two weeks more business is likely to mark time.

The steel industry is admittedly quiet. The railroads are the chief buyers. But production and orders have both been increasing lately and the industry seems to have passed its low point. Copper is a shade firmer, but featureless.

There is less building and more unemployment. A prominent contractor says that "America has caught up with herself in construction and production." He adds that we may make a fresh start after election, but that he doubts it unless wages and material decline.

In a general way his observations seem applicable to most lines of business in the United States. The shipping trade is, however, an exception. With a worldwide commercial revival ships ought to earn more.

What's Doing in Industry

Business in the machinery and machine tool field was quiet last week and indications are that it will remain quiet for at least two weeks more. But despite this condition, better times seem to be just ahead and builders and dealers are not pessimistic over the future outlook. Automobile production has improved and is steady, general industrials are fairly well employed and the railroads are buying more equipment at the present than at any other time during the year. All of these facts presage machine tool buying by automobile makers, freight car and locomotive builders and the railroads themselves.

The importance of the radio business is being felt more each day and many dealers have been able to realize a good business from this field. Its gradual stabilization should be a great aid to the machine tool industry as a whole.

General business is not brisk and reports show that undoubtedly the forthcoming election is having its effect upon all lines. After Nov. 4 orders should be more plentiful.

The German loan was the talk of Wall Street and its oversubscription shows with what readiness money can be raised in this country for any legitimate purpose. The volume of trading in stocks was light during the week with the only important movement being an advance in all rail stocks controlled by the Van Sweringens.

Freight Traffic Declines in August

Freight traffic on the Class 1 railroads in August was 9.7 per cent less than a year ago, and for the first eight months of the year was 10 per cent less than that of a year ago, the Bureau of Railway Economics reports. The net ton-miles of freight handled in August was 36,442,340,000 or 3,901,890,000 less than a year ago.

The Industrial Review

Progress of the machinery and machine-tool business in various parts of the country

THE following reports, gathered from the various machinery and machine tool centers of the country, indicate the trend of business in these industries and what may be expected from the future:

New York

Business remained quiet again this week in the New York district with some few inquiries received and some orders placed, but most dealers in the machinery and machine tool line have come to the conclusion that the month of October will be a dull month and not up to the business done during September.

Railroads bought sparingly, the New York Central and the Southern Railway being the best customers. Railroad equipment builders have recently received large orders from the roads and it is expected that they will be in the market before the end of the month. Machine tool builders and dealers in New York state are watching the developments of the Lackawanna with its proposed new shops near Binghamton. It is understood that land has been purchased and that buildings and machinery will be contracted for within a short time.

News of the re-opening of the London, Ontario, factory of the Ford Motor Co. of Canada was welcomed by machine tool men in as much as when this factory was closed seven months ago, all of the machine tools were shipped to South Africa and the factory must be re-equipped throughout at this time.

Eastern automobile makers are not buying any tools of importance, but they are producing steadily which means that they will be in the market probably before the first of the year.

The demand for used tools has dropped off considerably during October.

Canada

The tone of the metal-working industry in Canada continues good. The larger engineering shops are engaged in heavy orders, and new business appears to be shaping up in a way that will assure future work. Among the smaller concerns orders are being sought very keenly, and are being filled with remarkable celerity. In the machine tool field small goods are moving fairly freely, but there is very little movement of heavier equipment. Railroad shops have issued small lists, mostly calling for equipment for replacement purposes.

Evidences of an improvement in general industry are to be gained in several directions, although expansion has not been quite as rapid as some had thought probable earlier in the season. Nevertheless the reopening of several steel furnaces recently gives indication of a more cheerful spirit. Especially heartening was the recent announcement that the 3,300 men now employed at the Sydney mill of the British Empire Steel Corp. would be retained at least until the end of the year. Extensive repair work is being carried on at this plant. Employment has improved noticeably throughout the country during the past three weeks in manufacturing, logging and general business. Car loadings for the week ended Oct. 4, were 71,384 as compared with 70,437 for the week ended Sept. 27.

Business covering the past month in the scrap market has been better than for any corresponding period this year. Many melters have come forward in the past two weeks with contracts covering last quarter requirements, but dealers declare there is still considerable tonnage to be placed in this account.

An improvement is reported in building operations all over the Dominion. This is especially noticeable in the Montreal district. Permits totaling $3,500,000 were issued during September in Montreal proper, the largest monthly total of the year.

The pig iron market is still quiet. Substantial business is reported in the non-ferrous metals. Babbitt metal is in fairly good demand, and shares its popularity with copper castings.

The recent cooler weather has caused an active trade in stoves and heating goods. Coming at this early period this augurs well for fall trade. The dealers' stocks are not large and therefore restocking is expected to commence on a fairly large scale before long. The new trade tready with Australia will undoubtedly stimulate Canadian export business in motor cars and newsprint. Under this new agreement the Australian duty on automobiles and parts is reduced 2½ per cent while the duty of three pounds per ton on printing paper is eliminated. The agreement will be operative by proclamation on a date to be agreed upon later.

Detroit

Hope that the next six weeks will witness a revival of the activity that featured the Detroit market of machine tools and machinery during the early part of the year is expressed by leaders in the field in this city.

That these hopes are based upon a solid foundation of facts is stressed by leaders who anticipate improvement in the automobile and accessory lines during the latter part of 1924.

Inquiries as reported by representatives in Detroit are on the increase with a very good percentage of such inquiries resulting in actual sales. A slow rise in employment figures gives an index to the bettered condition in the automotive field, especially among some of the more popularly priced cars with large production totals.

There is apparently no reason to believe that 1924 will exceed 1923 from the standpoint of sales and many dealers are hoping that the remainder of the year will be at least the average for the first nine months.

Lathes and milling machines appear to be in slightly better demand than has been true recently, while special jobs as required by so many of the highly specialized plants in the Detroit industrial area are being secured by some vendors.

Many automobile manufacturers are beginning to shop for new equipment in anticipation of a resumption of normal production next year. This is helping materially to brighten the outlook among machine tool leaders.

General business conditions have changed but little recently. Railroad movements remain somewhat stationary.

Southern District

While there appears to have been but little improvement in machine tool and equipment sales in the Southern district in the past two or three weeks, inquiries are picking up somewhat and there is excellent promise of business to come during the last half of October and the earlier part of November. General business conditions in the district have been getting steadily better for the past month due to excellent agricultural prospects, and the metal trades are beginning to get the benefits of this to some extent. Indications at present are that Southern farmers will this year enjoy one of their most prosperous seasons in years, and machinery distributors state that this is bound to have a favorable influence on their business also over the entire South.

A late report of the Southern Metal Trades Association relative to conditions in the machinery and metal trades industries shows marked improvement over the last report issued late in the summer, with nearly all members reporting orders in hand, inquiries, collection and outlook fair to good. The improvement over the last report amounts to about 20 to 25 per cent, and is particularly optimistic as regards the metal trades outlook for the next 90 days.

Quite a bit of buying of both new and used equipment is still being done by the railroads, and inquiries continue comparatively heavy, indicating this business will likely continue to hold up on this basis for the next few weeks at least. Undoubtedly this will prove to be one of the best years dealers and distributors catering to railroads have enjoyed, for this trade has

been active since the early part of the present year.

Also, a fair amount of buying is being done at present by the smaller machine shops, service station and similar enterprises, probably a little better than the latter part of September, but most of this business is in second-hand equipment.

Little or no improvement is noted in the textile industries, though the outlook is improving and the trade is more optimistic over this field than in several months. Fair buying is looked for through the winter months, and marked activity next spring.

New England

Some fairly heavy buying for the automotive industry, during the week in New England was reported by sales managers. The business closed was the consequence of inquiries dating back in some instances three months and is cited as illustrative of the slow development of trade. In general during the past week there was a better closing of orders, but it was attended by a small falling off in the inquiries. The future business outlook, judged from the mail, indicated weight being with the automobile industry. Some of this is special machinery, but the bulk of it is standard automatic equipment and is calculated to be of the replacement variety.

Railroad shop business was of good volume during the week just closed. Most of this was of the small hand tool variety.

There has been a falling off in the typewriter business, but it is not of the amount to necessitate any slowing up of production, despite reports of extensive reductions in working forces. In Bridgeport there was a noticeable improvement in the general machine trade, indicated by increased employment in at least three shops.

The second-hand machinery trade is now slowing up and those engaged in this line are slow to increase their stock, even at advantageous price at which offerings are to be had.

Indiana

Little change is to be seen in the demand for machine tools and metal working machinery. The demand is considerably spotted, judging from reports from some of the larger plants. The machinery end of the trade appears to be slower than tool demands. Of more than usual interest to the trade here last week was the Industrial Exposition, which in some respects resembled a display of machinery. Dozens of local firms displayed their wares and for the local public the exposition was an educational course in the innumerable metal products manufactured here.

In some lines, however, the machinery trade is good. The textile mills of the state are working more than they have for several months and this increased production is creating a new demand for specialized machinery. There is a big increase also in demand for coal mining machinery. Each week sees more mines resuming operation in the Indiana field and for the last two weeks this demand has been better than was looked for.

Where demand for tools has decreased slightly with the automobile factories during the last week, demand from the railroads and public utilities, and particularly the independent car manufacturing plants, has increased to a respectable volume.

Milwaukee

With a few conspicuous exceptions, the demand for metalworking equipment continues rather slow. The exceptions include purchases of round lots, by the A. O. Smith Corp., Milwaukee, and the Ajax Motors Co. of Racine, Wis. The latter interest so far has been buying piecemeal, but there appears to be a large quantity of equipment to be purchased shortly.

The business of local machine tool manufacturers received some stimulation from the presence of a large number of executives in Milwaukee at the American Foundrymen's Association convention and exposition during the week of Oct. 12 to 18. Machine tool plants in this district were generously visited and a great many sales of single items, largely special types of equipment recently developed to serve manifold purposes and make efficient replacements.

The dearth of industrial construction, which has exerted a noticeably adverse effect upon business in metalworking equipment, has not been relieved, but it is found that some important interests are planning new buildings. Generally, however, this work is largely meant as replacement in line with the endeavor to modernize plants. The character of business being taken by foundries and machine shops is not such as to make necessary any important shop extensions. These shops are fairly busy, but forward orders are lacking in many cases, making it difficult to anticipate needs and necessary to make frequent readjustments of production schedules and operating forces.

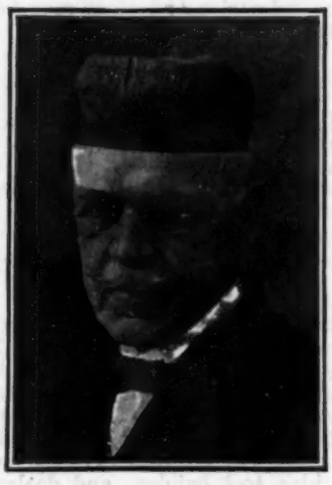
There is a feeling in the local tool trade that the early part of November should relieve the real or imaginary uncertainty that seems to exist, and business go forward at its accustomed pace through the coming winter, with a correspondingly greater degree of activity in the movement of equipment as soon as the general betterment takes place in the various lines that the machine tool industry is dependent upon.

Sheet & Tube Sells Machine Shops

In line with policy to divest itself of properties not directly required for iron and steel manufacture, the Youngstown Sheet & Tube Co. has sold the Tri-State Engineering Co. at Zanesville to L. A. Woodard of Wooster. The Zanesville company manufacturers boilers and engines, conducts a foundry and operates a machine shop.

Obituaries

HENRY ROBINSON TOWNE, former president of the A.S.M.E. and for many years president of Yale & Towne Manufacturing Co., maker of locks, Stamford, Conn., died on Wednesday evening, Oct. 15, at his residence in New York City. He was born in Philadelphia in 1844 and studied at



Henry Robinson Towne

the University of Pennsylvania during 1861-62, receiving Hon. A.M. there in 1887. He began his active career as an engineer by entering the drafting room of the Port Richmond Iron Works. In 1864-66 he was in charge of erecting engines in the monitors "Monadnock" and "Agamenticus" and similar work until the war closed. After the war he became a special student of Robert Briggs, carrying on numerous experiments on leather belting, accepted as standard for about twenty years. He also took a special course in physics at the Sorbonne in Paris, about this time. In the summer of 1868 he became associated with Linus Yale in the manufacture of locks, where for almost thirty years every improvement in locks or lock making came through his keen ability as mechanic and business man, and after Mr. Yale's death he became president of the company. Mr. Towne was a life member of the A.S.M.E., vice-president 1884-86 and president 1888-89. He wrote many technical papers.

CARL J. MELLIN, consulting engineer of the American Locomotive Co., a designer and patentee of many locomotive devices and improvements, died at his home in Schenectady recently. He was largely instrumental in the design of the three-cylinder locomotive and at the time of his illness was working on the three-cylinder compound locomotive. Among his other works was the design of the Richmond locomotive.

GEORGE WALTON BAKER, aged 87 years, died recently at his home in Wilmington, Del. He was the president of the G. W. Baker Machine Co. of that city.

Personals

WALTER HELBER of Flint, Mich., has been named general superintendent of the plant of the Ajax Motors Co., Racine, Wis., which is arranging to place in operation the old Mitchell automobile factory. Mr. Helber began his career with the Cadillac Motor Car Co., and in 1912 joined the Buick Motor Co. as general toolroom foreman, being promoted to assistant superintendent of the motor plant in 1917, and following the war, became master mechanic of the motor plant.

WILSON P. HUNT, president of the Moline Tool Co., Moline, Ill., was elected a director of the National Machine Tool Builders' Association for a term of three years at the annual meeting held at Lenox, Mass., early in the month.

Wilson P. Hunt

RUSSELL C. BALL has been elected president and treasurer of the Philadelphia Gear Works, Philadelphia, Pa., and R. J. COULTER has been elected vice-president and secretary. George L. Markland, Jr., is chairman of the board of directors.

WILBUR C. MILLER, formerly editor of the *Syracuse Journal*, has been appointed general manager of the Flexible Machine Co., Syracuse.

J. A. GEMERICK has been named general manager of the Brightman Manufacturing Co., Columbus, Ohio.

J. F. GAFFNEY, formerly with the Hadfield-Penfield Steel Co., has been appointed general foundry superintendent of the Toledo Machine & Tool Co., Toledo, Ohio.

EDWARD C. BYWATER has been appointed Ohio representative for the Crescent Truck Co., Lebanon, Pa. His headquarters will be at 1997 Central Ave., Cincinnati, Ohio.

DR. W. WALDSCHMIDT and HEINRICH SAUTER of Ludw. Loewe & Co., A. G., Berlin, are spending two months in the United States in an endeavor to re-establish old connections broken by the war and to form new ones.

THEODORE PILGER, of Loup City, Neb., formerly sales engineer of the Allis-Chalmers Manufacturing Co., New York City, has been named Trade Commissioner attached to the Department of Commerce Berlin office.

A. R. GLANCY, president and general manager of the Waukesha Malleable Iron Co., of Zanesville, Wis., has been appointed vice-president and general manager of the Oakland Motor Car Co. in direct charge of production.

L. M. STELLMAN, chief engineer of the H. H. Franklin Manufacturing Co., has joined the Skinner Motor Device Co., Inc., of Detroit, in the capacity of consulting engineer.

T. H. MCWILLIAM has been appointed general manager of the Montreal office of the Canadian-Fairbanks-Morse Co. Mr. McWilliam was formerly manager of the Ottawa branch of the company.

J. G. GARDNER, president of Machinery & Foundries, Brockville, Ontario, has been appointed a director of the Canadian National Railways.

F. E. BROWN has been placed in charge of the engineering and production departments of Joseph N. Smith & Co., Detroit, makers of automobile accessories.

W. C. GEER, vice-president in charge of research work of the B. F. Goodrich Co., Akron, Ohio, will sever his affiliation with the company next year.

JAMES W. BRYDEN, receiver of the America Bearing Co., Milwaukee, will offer the entire assests for sale at the office of the plant, Forty-seventh Ave. & Rogers St., in West Allis, on Friday, Nov. 14.

Business Items

The H. A. Smith Machinery Co., 501 E. Water St., Syracuse, N. Y., has been appointed exclusive agent in the Syracuse district for the Rockford Milling Machine Co., Rockford, Ill.

The Gibb Instrument Co., Bay City, Mich., has broken ground for a new plant in that city.

The Beaudry Co., Inc., Everett, Mass., has moved into its new building at Revere Beach Parkway.

The Bedford Machine Tool Co., 166 Bedford Road, Toronto, has purchased the building of the Mahaffey Iron Works, 145 Kendal Ave. The new owners will immediately remove their machinery to the new building, and the Mahaffey Iron Works will seek larger quarters.

The Macnamara Motor Wheels, Ltd., St. Mary's, Ontario, has been incorporated with a capital of $300,000 by R. E. Macnamara, L. A. Bell and others.

The Hicks Engine Corp., capitalized at $1,000,000, has been organized in San Francisco, Calif., with the following directors: D. C. Demarest, M. H. Manuel, L. Monte Verda, F. H. Oliphant, P. S. Austin, F. B. Ench and S. H. Demarest.

Bids have been received on the Hill Pump Works of Anderson, Ind., a branch of the Midwest Engine Co. of Indianapolis, by Judge Mahlon E. Bash, in the Marion County probate court, where the affairs of the Anderson branch have been pending. The sale of the plant was postponed two weeks in order to give each of the two bidders an opportunity to increase their bids. A syndicate, said to be headed by James P. Goodrich, submitted a bid of $177,810.40 for the property.

The Youngstown Sheet & Tube Co. is conducting negotiations to sell the plant of the Harrow Springs Co. at Kalamazoo, Mich.

Uruguay Will Prohibit Left-Hand Drives

Left-hand driven vehicles will not be permitted to be registered in Uruguay after March 4, 1925, according to a resolution in the Departmental Council at Montevideo, cabled by Trade Commissioner L. B. Clark to the Department of Commerce. The resolution gives public notice that the Wheeled Traffic Division of the local government would not register any automobile, truck or other similar vehicle of mechanical traction, the driving or steering gear of which was not on the right hand side of the vehicle. It also provides that the entrance to the front seat or seats must be on the left hand side. Such entrance is required, but an entrance on the right hand side of the car is optional with the owner.

According to the original resolution of Sept. 4, this restriction on left-hand driven cars was to have come into effect on Jan. 1, but upon local representations has been extended to March 4.

Forthcoming Meetings

Management Week. Under the auspices of the American Society of Mechanical Engineers. Week of Oct. 20, 1924. Simultaneously held in leading cities.

Society of Automotive Engineers. Production meeting. General Motors Building, Detroit, Mich., Oct. 22, 23 and 24. C. S. Clarkson, secretary.

American Welding Society. Annual Convention, Cleveland, Oct. 30 and 31. Miss M. M. Kelly, 29 W. 39th St., New York City.

American Society of Mechanical Engineers. Forty-fifth annual meeting. New York City. Dec. 1 to 4. Calvin Rice, secretary, 29 West 39th St., New York City.

National Exposition of Power and Mechanical Engineering. Grand Central Palace, New York City, Dec. 1 to 4. Charles F. Roth, 1102 Grand Central Palace Building, New York City.

Exposition of Invention. Engineering Societies Building, 29 West 39th St., New York City. Dec. 8 to 13 inc., General offices, 47 West 34th St., New York City.

American Association for the Advancement of Science. Meeting at Washington D. C., Dec. 29, Jan. 1, 2 and 3. Burton Livingston, Smithsonian Institute, Washington, D. C.

Society of Automotive Engineers. Annual Meeting. Detroit, Mich., Jan. 20, 21, 22 and 23. C. F. Clarkson, 29 W. 39th St., New York City.

The Weekly Price Guide

Rise and Fall of the Market

Iron and Steel—Active shipments of pig iron are cutting into reserve stocks, prices holding firm at same levels prevailing a week ago. Railroads continue to take bulk of steel tonnage now being sold. Some weakness in steel shapes has developed during the week; quotations now $1.90 @$2 per 100 lb., Pittsburgh. Bars are firm, however, at $2, while plates bring $1.60@$1.90 per 100 lb. at mill.

Non-Ferrous Metals—Principal non-ferrous metals firmer all along the line in domestic market. Electrolytic copper advanced ¼c.; lead and zinc ⅛c. per lb. in New York warehouses since Oct. 10. Tin reported declining in foreign market.

Linseed Oil—Raw oil up 5c. per gal. in 5-bbl. lots in New York, Oct. 15, making the second advance since the tenth of the month.

(All prices as of Oct. 17)

IRON AND STEEL

PIG IRON—Per gross ton f.o.b.:

CINCINNATI	
No. 2 Southern	$21.55
Northern Basic	21.27
Southern Ohio No. 2	21.77
NEW YORK—Tidewater Delivery	
Southern No. 2 (silicon 2.25@2.75)	25.10
BIRMINGHAM	
No. 2 Foundry	18.00
PHILADELPHIA	
Eastern Pa., No. 2x (silicon 2.25@2.75)	22.34
Virginia No. 2	29.75
Basic	21.25
Grey Forge	21.25
CHICAGO	
No. 2 Foundry local	20.50
No. 2 Foundry, Southern (silicon 2.25@2.75)	24.50
PITTSBURGH, including freight charge from Valley	
No. 2 Foundry	22.77
Basic	22.77
Bessemer	23.77

IRON MACHINERY CASTINGS—Cost in cents per lb. of 100 flywheels, 6-in. face x 24-in. dia., hub not cored, good quality gray iron, weight 275 lb.:

Detroit	4.75
Cleveland	4.75@5.00
Cincinnati	5.00@7.50
New York	5.00@5.50
Chicago	5.25@5.75

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the mill base in large lots.

Blue Annealed	Pittsburgh Mill Base	New York	Cleveland	Chicago
No. 10	2.60@2.70	3.89	3.45	3.80
No. 12	2.70@2.80	3.94	3.50	3.95
No. 14	2.80@2.90	3.99	3.55	4.00
No. 16	3.00@3.10	4.09	3.65	4.10
Black				
Nos. 17 and 21	3.25@3.35	4.40	4.15	4.55
Nos. 22 and 24	3.30@3.40	4.45	4.20	4.55
Nos. 25 and 26	3.35@3.45	4.50	4.25	4.60
No. 28	3.40@3.50	4.60	4.35	4.50
Galvanized				
Nos. 10 and 11	3.50@3.60	4.60	....	4.60
Nos. 12 and 14	3.60@3.70	4.70	....	4.70
Nos. 17 and 21	3.[illegible]@4.00	5.00	....	5.00
Nos. 22 and 24	4.[illegible]@4.15	5.15	3.00	5.15
No. 26	4.2[illegible]@4.30	5.30	4.15	5.30
No. 28	4.50@4.60	5.60	5.45	5.50

WROUGHT PIPE (Welded)—Warehouse discounts are as follows:

	New York Black	New York Galv.	Cleveland Black	Cleveland Galv.	Chicago Black	Chicago Galv.
1 to 3 in. steel butt welded	48%	34%	55½%	43½%	56%	43%
2½ to 6 in. steel lap welded	44%	30%	53½%	40½%	53%	40%

Malleable fittings: Classes B and C, banded, from New York stock sell at list plus 4%; class A, plus 23%. Cast iron, standard sizes, 36% off.

SEAMLESS STEEL TUBING—Following base discounts are on 20 gauge or .035-in., round, cold-drawn tubing, ⅛-in. to 1-in., O.D., weighing 0.17 lb. to 0.36 lb. per ft. Cutting charge per 100 cuts, $1.50 to $1.58:

O.D. Inches	List Price per ft.	Differential Discount	O.D. Inches	List Price per ft.	Differential Discount
⅛	$0.09	50%	⅞	$0.16	35%
¼	.11	45%	1	.18	31%
⅜	.14	40%			

NOTE—The discounts are to be lowered by the following differentials in the case of regular .10-.20 carbon: 25,000 ft. or over, 83; 15,000 to 25,000 ft., 82; 5,000 to 15,000 ft., 81; 1,000 to 5,000 ft., 80; less than 1,000 ft., 79.

MISCELLANEOUS—Warehouse prices in cents per pound in 100-lb. lots:

	New York	Cleveland	Chicago
Open hearth spring steel (base)	4.50	6.00	4.20
Spring steel (light) (base)	7.00	6.00	6.00
Coppered Bessemer rods (base)	6.85	8.00	6.55
Hoop steel	4.49	4.35	4.15
Cold rolled strip steel	7.00	8.25	7.15
Floor plates	5.55	4.60	5.50
Cold drawn shafting or screw	4.05	3.90	3.80
Cold drawn flats, squares	4.55	4.40	4.30
Structural shapes (base)	3.34	3.20	3.10
Soft steel bars (base)	3.24	3.10	3.00
Soft steel bar shapes (base)	3.24	3.11	3.00
Soft steel bands (base)	3.99	3.20	3.65
Tank plates (base)	3.34	3.42½	3.10
Bar iron (2.90@3.00 at mill)	3.24	3.21	3.00
Tool steel	11.00	....	....
Drill rod (from list)	60%	55%	50%

Electric welding wire, New York, 1/32, 8.35c.; ⅛, 7.85c.; 1/32 to ¼, 7.35c. per lb.

METALS

Current Prices in Cents Per Pound

Copper, electrolytic (up to carlots), New York			13.75
Tin, 5-ton lots, New York			50.75
Lead (up to carlots), St. Louis	7.85	New York	8.62½
Zinc (up to carlots), St. Louis	6.30	New York	7.12½

	New York	Cleveland	Chicago
Aluminum, 98 to 99% ingots, 1-15 ton lots	27.10	28.00	28.50
Antimony (Chinese), ton spot	12.00	13.25	10.00
Copper sheets, base	20.12½	20.12½@20.62½	23.00
Copper wire, base	18.12½	18.50	21.75
Copper bars, base	19.37½	20.37½	22.50
Copper tubing, base	22.25	23.25	25.75
Brass sheets, base	16.87½	16.87½	19.75
Brass tubing, base	21.00	22.00	28.25
Brass rods, base	14.62½	15.62½	17.50
Brass wire, base	17.37½	18.75	20.25
Zinc sheets (casks)	10.60	11.10	....
Solder (⅛ and ¼), (case lots)	37@38	32.50	30.00
Babbitt metal (83% tin)	60.00	59.25	48@52
Babbitt metal (35% tin)	28.00	18.50	23@26
Nickel (ingots) f.o.b. refinery	29.00	.....	.....
Nickel (electrolytic) f.o.b. refinery	33.00	.....	.....
Nickel (F shot) f.o.b. refinery	30.00	.....	.....

SPECIAL NICKEL AND ALLOYS—Price in cents per lb., f.o.b. Huntington, W. Va.:

Rolled nickel sheet (base)	52.00
Hot rolled rods, Grade "A" (base)	50.00
Cold drawn rods, Grade "A" (base)	58.00

Shop Materials and Supplies

METALS—Continued

Manganese nickel hot rolled rods "E"—low manganese (base) 54. 00
Manganese nickel hot rolled rods "D"—high manganese (base) 57. 00

Base price of monel metal in cents per lb., f.o.b. Huntington, W. Va.:

Shot	32. 00	Hot rolled rods (base)	40. 00
Blocks	32. 00	Cold drawn rods (base)	48. 00
Ingots	38. 00	Hot rolled sheets (base)	42. 00

OLD METALS—Dealers' purchasing prices in cents per pound:

	New York	Cleveland	Chicago
Crucible heavy copper	10.75@11. 25	10.25	11 00
Copper, heavy, and wire	10.50@10. 75	10.00	10 50
Copper, light, and bottoms	9.25@ 9.50	9 25	9.50
Heavy lead	6.25@ 6.50	6.25@6 50	7.00
Tea lead	5.25@ 5. 50	5.25@5.50	5.50
Brass, heavy, yellow	6. 50@ 6. 75	6.50	7.00
Brass, heavy, red	8. 50@ 8.75	8.50@8.75	8.50
Brass, light	5. 50@ 5. 75	5.50	6.00
No. 1 yellow rod turnings	7.00@ 7.50	7.25	7.00
Zinc	3.75@ 4.00	3.75	3.50

TIN PLATES—American Charcoal—Bright—Per box.

		New York	Cleveland	Chicago
"AAA" Grade:				
IC,	20x28, 112 sheets	$23. 50	$22. 85	$21. 00
"A" Grade:				
IC,	20x28, 112 sheets	19. 00	18. 80	17. 00
	Coke Plates—Primes, 20x28 in.			
100-lb.,	112 sheets	13. 00	13. 00	12 75
	Terne Plates—Small lots, 8-lb. Coating			
IC,	14x20	7. 25	6.80@6.90	6.50@6.75

MISCELLANEOUS

	New York	Cleveland	Chicago
Cotton waste, white, per lb.	$0. 14@0. 21	$0.19	$0. 14
Cotton waste, colored, per lb.	. 09@ .14½	.18	. 10½
Wiping cloths, 13¼x13¼, per lb	11.00@11.25*	36. 00 per M	. 16
Wiping cloths, 13¼x20½, per lb.	....	50. 00 per M	. 16
Sal soda, per 100 lb. keg	2. 25	2. 25	2. 65
Roll sulphur, per 100 lb. keg	3. 60	3. 25	3. 50
Linseed oil, per gal., 5 bbl. lots	1. 08	1. 11	1. 05
Lard cutting oil, 25% lard, per gal.	. 55	. 50	. 32
Machine lubricant, medium-bodied (50 gal. wooden bbl.), per gal.	.29	. 35	. 21
Belting—Present discounts from list in fair quantities (½ doz. rolls).			
Leather—List price, 24c. per lin. ft. per inch of width for single ply.			
Medium grade	40–2½%	30–10%	30–10%
Heavy grade	30–5%	30%	20–5–2½%
Rubber transmission, 6-in., 6 ply, $1.83 per lin. ft.			
First grade	50%	50–10%	40–10%
Second grade	50–10%	60–5%	60–5%
Abrasive materials—In sheets 9x11 in.,			
No. 1 grade, per ream of 480 sheets:			
Flint paper	$4. 86	$5. 84	$6. 48
Emery paper	10. 71	11. 00	8. 80
Emery cloth	28. 00	31. 12	29. 48
Emery disks, 6 in. dia., No. 1 grade, per 100:			
Paper	1. 49	1. 24	1. 40
Cloth	3. 38	2. 67	3 20
Fire clay, per 100 lb. bag		. 65	. 60
Coke, prompt furnace, Connellsville	per net ton		3. 00@3. 25
Coke, prompt foundry, Connellsville	per net ton		4. 25@4. 75
White lead, dry or in oil	100 lb. kegs	New York, 14. 75	
Red lead, dry	100 lb. kegs	New York, 14. 75	
Red lead, in oil	100 lb. kegs	New York, 16. 25	

*White, at washery.

Comparative Warehouse Prices

New York	Unit	Current Price	Four Weeks Ago	One Year Ago
Soft steel bars	per lb.	$0.0324	$0.0324	$0.0354
Cold finished shafting	per lb.	.0405	.0415	.0465
Brass rods	per lb	.1462½	.15	.1525
Solder (½ and ½)	per lb.	.37@.38	.385	.295
Cotton waste	per lb.	.14@.21	.14@.21	10@13
Washers, cast iron (½ in.)	per 100 lb.	6.50	6.50	6.50
Emery, disks, cloth, No. 1, 6 in. dia.	per 100	3.38	3.38	3.38
Lard cutting oil	per gal.	.55	.55	.55
Machine oil	per gal.	29	.29	.297
Belting, leather, medium	off list	40–2½%	40–2½%	30–10%
Machine bolts up to 1x30 in.	off list	50%	50%	40–10%

SHOP SUPPLIES

Current Discounts from Standard Lists

	New York	Cleveland	Chicago
Machine Bolts:			
All sizes up to 1x30 in.	50%	60%	60%
1½ and 1½x3 in. up to 12 in.	15%	.....	....
With cold punched hex. nuts up to 1 in. diam. (plus std. extra of 10%)	40%	$3. 50 net	.....
With hot pressed hex. nuts up to 1x30 in. (plus std. extra of 10%)	45%	3. 50 net	60%*
Button head bolts, with hex. nuts	10%	3. 50 net	.....
Hex. head and hex. nut bolts	10%	.....	.....
Lag screws, coach screws	50%	.....	65%
Square and hex. head cap screws	75%	75–10%	.....
Carriage bolts, up to 1 in.x30 in.	40%	60%	55%
Bolt ends, with hot pressed nuts	50%	.....	60%
Tap bolts, hex. head, list plus	35%	.....	$4.65
Semi-finished nuts, ⅝ and smaller	70%	.....	.....
Semi-finished nuts, ¾ and larger	65%	70%	.....
Case-hardened nuts	50%	.....	.....
Washers, cast iron, ½ in., per 100 lb. (net)	$6. 50	$4. 00	$3.75
Washers, cast iron, ¾ in., per 100 lb. (net)	5. 50	4. 00	3.75
Washers, round plate, per 100 lb. Off list	1. 50	5.00	4.50
Nuts, hot pressed, sq., per 100 lb. Off list	1. 50	4.00	4.00
Nuts, hot pressed, hex., per 100 lb. Off list	1. 50	4 00	4 00
Nuts, cold punched, sq., per 100 lb. Off list	1. 50	4.00	4.00
Nuts, cold punched, hex., per 100 lb. Off list	1. 50	4.00	4.00
Rivets:			
Rivets, ⅞ in. dia. and smaller	50%	60–10%	70%
Rivets, tinned	50%	60–10%	70%
Button heads ¾-in., ⅞-in., 1x2 in. to 5 in., per 100 lb. (net)	$5. 00	$3.50	$3. 50
Cone heads, ditto (net)	5.20	3.60	3. 70
1½ to 2-in. long, all diameters, *EXTRA* per 100 lb.	0. 25	.....	0. 15
¾ in. diameter *EXTRA*	0. 35	.....	0. 15
½ in. diameter *EXTRA*	0. 75	.....	0. 50
1 in. long, and shorter *EXTRA*	0. 75	.....	0. 50
Longer than 5 in. *EXTRA*	0. 50	.....	0.2[illegible]
Less than 200 lb. *EXTRA*	0. 50	.....	0. 50
Countersunk heads *EXTRA*	0. 45	.....	. ..

*Square.

Machine Requirements and Industrial Construction

Machine Tools and Equipment Wanted

Conn., Bridgeport—The Marican Chain Co., 829 Connecticut Ave.,—chain testing machinery.

Ill., Chicago — International Harvester Co., 606 South Michigan Ave.—one 2 in. upsetter and one 500 ton crank press.

Ill., Chicago — Midland Structural Steel Co., 1300 South 54th Ave.—10 ton a.c. crane, 60 ft. span and rotary planer, 30 to 42 in. cutting head.

Ill., Cicero—Midland Structural Steel Co., 1300 South 54th Ave.—radial drill with 12 or 14 ft. arm suitable for heavy reaming or drilling, Bethlehem H columns.

Ind., Indianapolis — Indianapolis Bolster Spring Co., 326 W. Georgia St.—plate shear with 48 x 1 in. and 24 x 1¼ in. capacity, hydraulic press to punch 8 in. discs thru 1 in. plate.

Mass., Boston—H. E. Cline, 43 Tremont St. — equipment for automobile repair garage, at Washington St., Roxbury.

Mass., Boston—Schoolhouse Dept., City Hall—metal and woodworking machinery for manual training department in the new $1,000,000 East Boston High School.

Mass., Boston — Oliver Whyte Co., 73 Cornhill—squaring shear to take at least 14 gauge sheets.

Mass., Clinton — The Wickwire Spencer Steel Corp.—equipment and machinery for enlargement of plant.

Mass., Lynn — Stevens-Mader, Inc., 75 Exchange St.—machinery and various tools for garage repair shop.

Mich., Detroit—F. Jos. Lamb Co., 1938 to 1970 Franklin St.—No. 16 Blanchard surface grinder, direct motor driven with a 220 v., 60 cycle, 3 phase motor (used).

Mich., Highland Park—Ford Motor Co.—several band saws for L'Anse branch.

Mo., St. Louis—St. Louis Casting Co., 118 Malt St.—200 to 300 ton hydraulic vertical press.

Neb., Hastings—C. Armstrong, c/o Hastings Machine Service Co.—used cylinder grinder.

O., Leetonia—Hanna Furnace Co.—steel two track trestles with aerial recarriers, also a crane with 900 ft. beam, etc.

O., Minerva—Volotone Mfg. Co., P. L. Pennock, Mgr.—metal working machinery to equip new shop for the manufacture of radios.

O., West Lafayette—Moore Enameling & Mfg. Co., H. A. Sicker, Mgr. (kitchen ware) —enameling equipment.

Pa., Ambridge—Central Tube Co.—15 or 25 ton overhead electric crane.

Pa., Pittsburgh — Carnegie Steel Co., Carnegie Bldg., C. L. Miller, Purch. Agt.—cranes, car dumpers, charging machines and transfer cars for Homestead and Carrie furnaces.

Pa., Pittsburgh — Duquesne Light Co., Chamber of Commerce Bldg.—100 ton crane.

Pa., Pittsburgh—Jones & Laughlin Steel Corp., Ross St.—2 crane trolleys for south side plant.

Pa., Pittsburgh—Natl. Tube Co., Frick Bldg., S. M. Lynch, Purch. Agt.—10 ton ore bridge long span for Lorain, Ohio, and a 10 ton ore bridge for McKeesport.

Tenn., Memphis—The Bluff City Boiler & Tank Works—1 double shears.

Tex., Marshall—D. R. Ware, 1504 West Grand Ave.—equipment for garage and machine shop.

Va., Roanoke—The Norfolk & Western Ry., O. S. Churchill, Vice-Pres.—1 double head car axle lathe, one 40 in. car wheel boring machine.

Wis., Chilton—Aluminum Specialty Co., 17th and Wollmer Sts., Manitowoc—heavy presses and rolls.

Wis., Kewaunee—F. Hamachek Machine Co., F. Hamachek, Purch. Agt.—tool lathe and drill press.

Wis., Kewaunee — J. Svoboda, (church furniture)—woodworking machinery.

Wis., Milwaukee—E. W. Clark Motor Co., 456 Jackson St.—repair shop machinery including grinder, drill press, air compressor, etc.

Wis., Waukesha — Quality Aluminum Casting Co., Lincoln Ave., A. Pankratz, Mgr.—aluminum working machinery including presses.

N. B. North Devon—W. D. Gunter—complete saw mill equipment to replace fire loss.

Ont., Barrie—A. Begg—boring machine and air compressor for garage and repair shop.

Ont., Bradford—Crake & Walker—emery grinder, bench lathe, tools, etc.

Ont., Bradford — J. Spence—machinery and equipment for sash and door manufacturing.

Ont., Collingwood—Collingwood Garage Co., J. Buel, Purch. Agt.—small lathe, press, etc.

Ont., Holland—D. Nolan—small lathe and drill press for garage and repair shop.

Ont., Ingersoll—G. C. Ellis—equipment for the manufacture of furniture.

Ont., London—Ford Motor Co., of Canada, W. R. Campbell, Gen. Mgr.—equipment for manufacturing auto accessories and special equipment for Ford Cars. Estimated cost $50,000.

Ont., Orillia — Canada Wood Specialty Co., Ltd., W. D. Mott, Secy. and Treas. (lumber and wood specialties)—woodworking machinery, (used) also saw mill machinery.

Ont., Paris—H. Sanderson & Co., Ltd.—woodworking machinery for manufacturing kitchen furniture.

Ont., Peterboro—G. Evans, George St.—lathe and drill press for garage.

Ont., Peterboro—W. Reid & Son, 26 Aylmer St.—miscellaneous tools and equipment for public garage.

Ont., St. Eugene—LaCelle & Son—equipment for sash and door manufacturing.

Que., Daveluyville — Daveluyville Chair Co.—woodworking machinery.

Que., Hull—Hull Iron & Steel Foundries, Ltd., F. Palen, Purch. Agt.—2 swinging grinders for 24 x 4 in. wheel and 2 stationary grinders for 24 x 4 in. wheel.

Que., Masham Mills—M. Bertrand—machinery for sash and door manufacturing.

Que., Matane — James Richardson Co., Ltd., S. De La Haye, Asst. Secy. (spoolwood and lumber)—spruce saw mill machinery.

Que., St. Bruno—T. Landry, (furniture) —woodworking machinery.

Que., St. Felicien—H. Morin—equipment for garage and repair shop.

Que., St. Valere de Bulstrode—A. Binette —complete equipment for saw mill. Estimated cost $15,000.

Eng., Bristol—J. Lysaght, Ltd.—complete equipment for the manufacture of galvanized sheet metal for the Montreal, Que., plant.

Opportunities for Future Business

Ariz., Phoenix—Sante Fe Railroad, Railway Exchange, Chicago, Ill., is having plans prepared for the construction of car shops and round house. C. F. W. Felt, Ch. Engr.

Calif., Oakland — General Electric Co., 5441 East 14th St., awarded the contract for the construction of a 1 story factory building on East 54th Ave.

Calif., San Francisco—Western Cooperage Co., 14th and Harrison Sts., awarded the contract for the construction of a 2 story factory on 14th St. near Harrison St. Cost about $100,000.

Ill., Mount Vernon—The Mount Vernon Car Mfg. Co., is receiving bids for the construction of a 1 story, 303 x 478 ft. car foundry. Neiler, Rich & Co., 431 South Dearborn, Chicago, Engrs.

La., Amesville—Celotex Co., is having preliminary plans prepared for the construction of a 1 and 2 story woodworking plant including machinery, power equipment, etc., to manufacture board from sugar cane. Plans to raise capacity of plant from 350,000 board ft. of celotex to 1,000,000 ft. per day.

Mass., Cambridge—Massachusetts Wharf Coal Co., 30 Kilby St., Boston, is receiving bids for the construction of a 1 story, 165 x 80 ft. garage and repair shop on Kendall Sq. Estimated cost $50,000. W. C. Cotter, 12 Harvard St., Somerville, Archt.

N. Y., Schenectady—General Electric Co., awarded the contract for the construction of a 5 and 15 story, 150 x 250 ft. plant.

O., Cincinnati — Houser, Stander Tank Co., S. Houser, Pres., awarded the contract for the construction of a 1 story, 60 x 300 ft. factory on Spring Grove Ave. Estimated cost $60,000.

O., Cleveland—C. J. Bath & Co., 1738 St. Clair Ave., awarded the contract for the construction of a 1 story, 67 x 94 ft. machine shop on East 69th St. Estimated cost $40,000.

O., Leetonia—Hanna Furnace Co., (steel) had plans prepared for extensive improvements to their plant increasing the capacity 10 to 15 per cent.

Okla., Tulsa—Bd. of Education, F. E. Duncan, Pres., will soon award the contract for the construction of a 2 story school building, including shop for manual training department.

Pa., Greensburg—W. F. Overly & Sons, cornice manufacturers, awarded the contract for a 2 story, 35 x 90 ft. addition to factory on West Otterman St. Estimated cost $40,000.

Pa., Pittsburgh—Terr-Put Auto Specialties Co., 7200 Race St., awarded the contract for the construction of a 2 story, 48 x 60 ft. shop on Washington Blvd. Estimated cost $40,000.

Wash., Seattle—The American Can Co., Foot of Clay St., awarded the contract for the construction of a 6 story, 120 x 360 ft. can factory on Cedar and Vine Sts. Estimated cost $800,000.

Wis., Chilton—Aluminum Specialty Co., 17th and Wollmer Sts., Manitowoc, awarded the contract for the construction of a 2 story, 62 x 100 ft. factory building. Estimated cost $50,000.

Wis., Kewaunee — J. Svoboda, awarded the contract for the construction of a 2 story, 50 x 133 ft. factory for the manufacture of church furniture and a 30 x 36 ft. boiler house. Estimated cost $50,000.

Wis., Waukesha — Quality Aluminum Casting Co., Lincoln Ave., A. Pankratz, Mgr., is receiving bids for a 1 story, 100 x 152 ft. addition to factory on Lincoln Ave. Private plans.